

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Commercial Webinar of the 2009 IECC and 90.1-2007

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Introductions

Stephen Rivera

Project email:

energycodeworkshop@shawgrp.com



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Overview

- Project funded by the Missouri Department of Natural Resources (MDNR) with American Recovery and Reinvestment Act of 2009 (ARRA) funding.

3 Locations:

1. St. Louis (December 1, 2011)
 2. Springfield (December 5, 2011)
 3. **Kansas City (January 25, 2012)**
- *Objective of the Workshop:* Work with municipalities and counties across the state to identify opportunities to adopt or enhance compliance with the 2009 International Energy Conservation Code (IECC) at a local level.

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Overview

- BCAP (Building Codes Assistants Program)
- BECP (Building Energy Codes Program)

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

What are the topics for today?

1. Overview of Best Practices and Lessons Learned in Missouri.
2. Commercial Compliance Approaches and Their Corresponding Tools.
3. Overview of the Requirements of Commercial Provisions of 2009 IECC
4. Commercial Resources - Building Data Collection Checklist and *COMcheck*.

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Agenda

Topic	Approx. Time
Introduction, Project Background, Workshop Overview	5 minutes
Overview of Best Practices and Lessons Learned in Missouri.	20 minutes
Commercial Compliance Approaches and their Corresponding Tools	25 minutes
Overview of the Requirements of Commercial Provisions of 2009 IECC	35 minutes
Commercial Resources - Building Data Collection Checklist and COMcheck.	25 minutes
Summary/Questions	10 minutes
Total Time	2 Hrs

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Some Important Points

Overall

- Focused on commercial
- Discussion-based
- Forum for ideas and practices

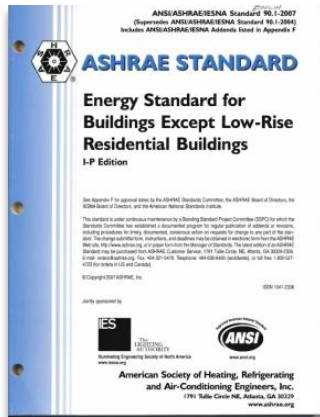
What can you expect?

- Code citations in []
- Webinar is Recorded and will be Available for 60 Days

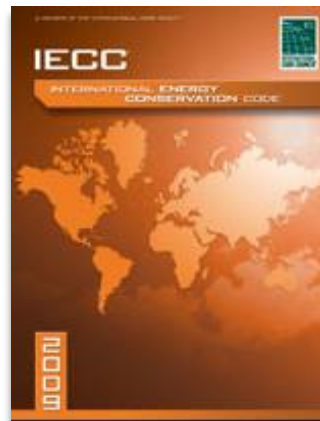
ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

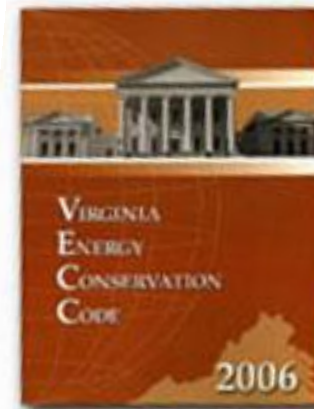
Building Energy Codes



ASHRAE Standard 90.1



International Energy Conservation Code



State and Locally Adopted Codes

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Comparison of 2009 IECC and ASHRAE 90.1-2007

2009 IECC

- 2009 IECC developed by the *International Code Council (ICC)*
- New version every three years with more stringent requirements

ASHRAE

- ASHRAE 90.1-2007 developed by *American Society for Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)*
- ASHRAE 90.1 is the referenced standard in IECC
- Compliance with ASHRAE 90.1-2007 results in 4% more energy savings than ASHRAE 90.1-2004

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

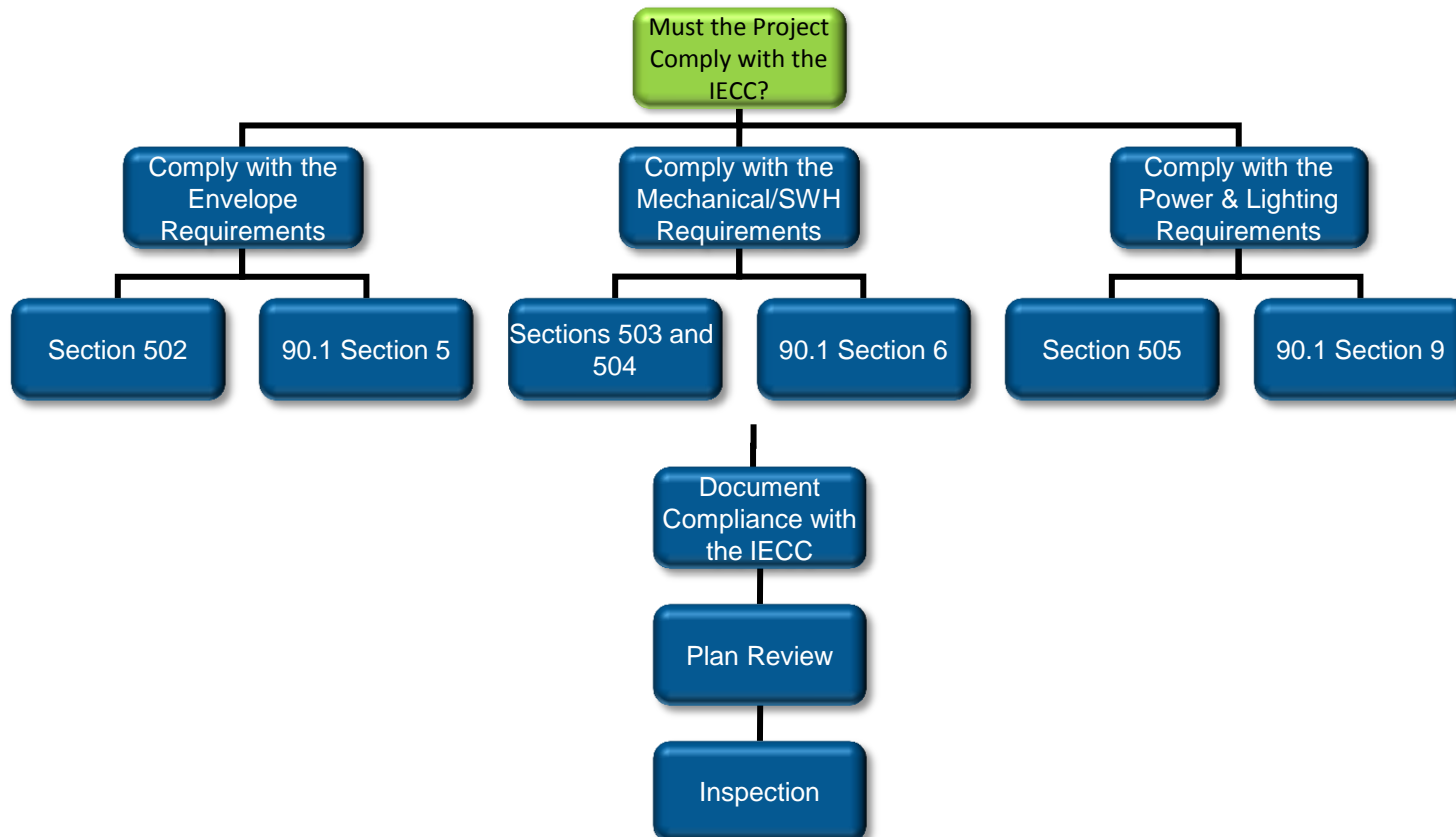
Model Codes & Standards

Title	Type	Applicability	Common Versions
International Energy Conservation Code (IECC)	Model Energy Code	Residential & commercial buildings; mandatory, enforceable language	2000IECC 2003 IECC 2006 IECC 2009 IECC 2012 IECC
ASHRAE Standard 90.1 Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings	Energy Standard	All buildings except residential 3 stories or less	90.1-2001 90.1-2004 90.1-2007 90.1-2010

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

2009 IECC Compliance



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Commercial Provisions Contained in Chapter 5

- Chapter 5 is dedicated to Commercial buildings in IECC
- ASHRAE 90.1-2007

Section 501.2 “Application” requires 90.1 to be used in its entirety (Envelope, Lighting, Mechanical).

****The Code does not allow for mixing and matching of IECC and ASHRAE**

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

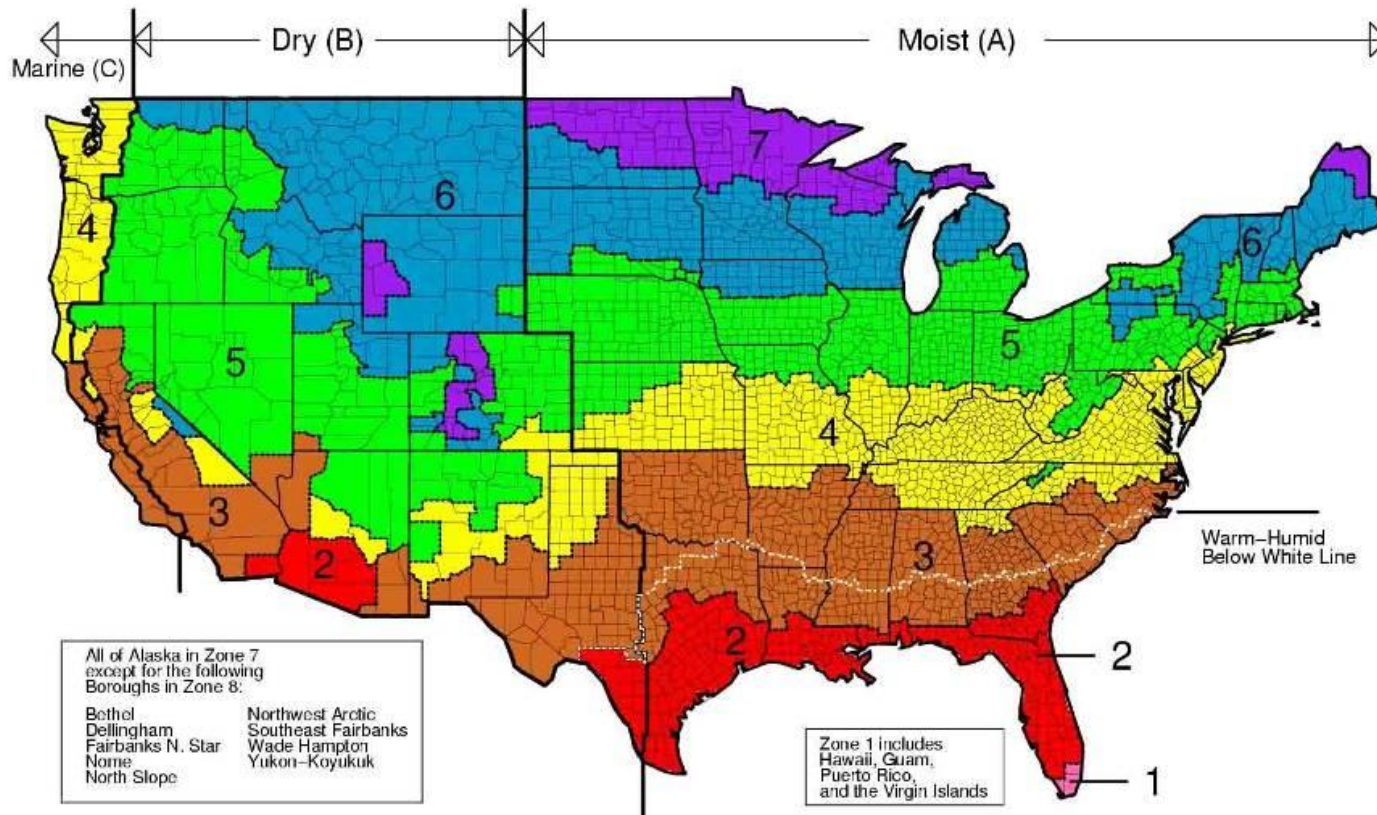
IECC or ASHRAE 90.1



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

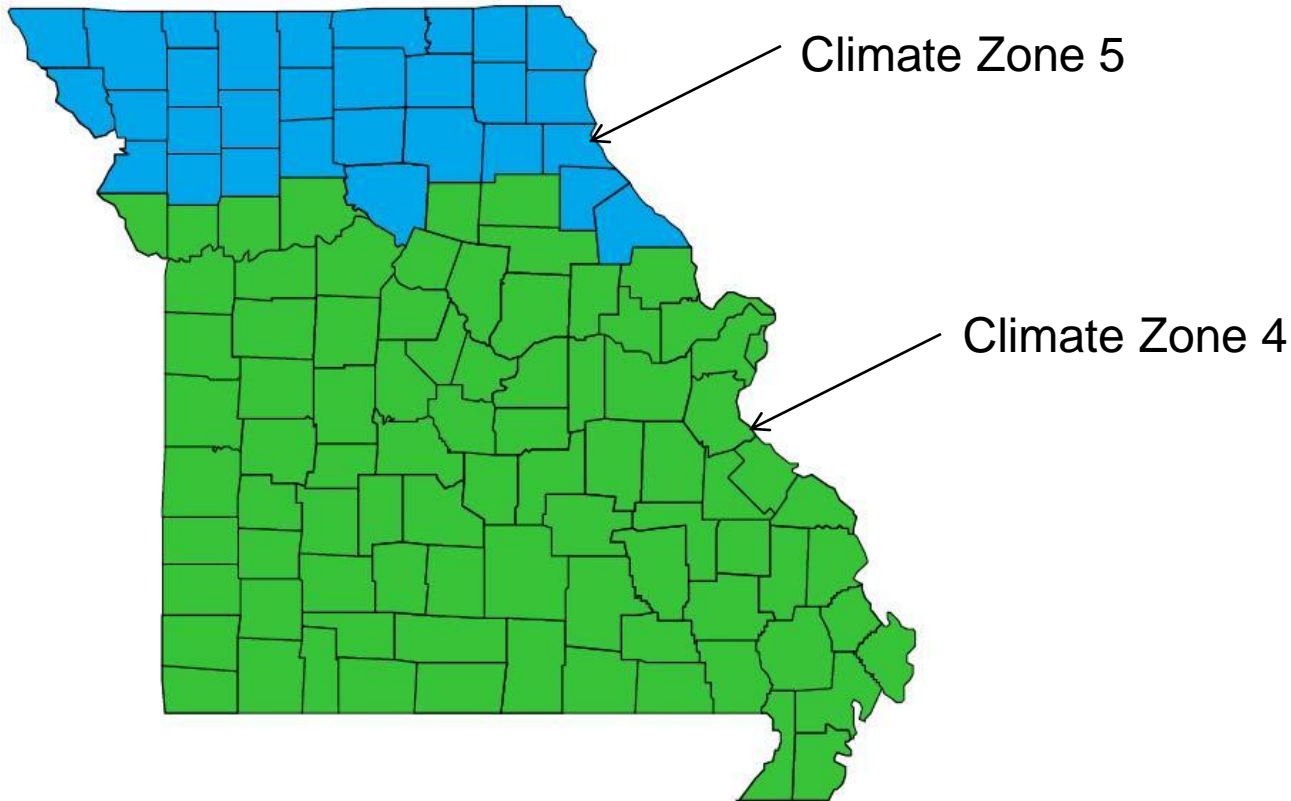
Climate Zones – 2009 IECC



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Climate Zones – 2009 IECC



ENERGIZE MISSOURI

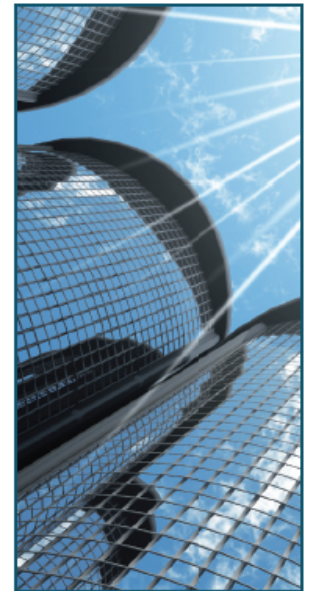
MISSOURI DEPARTMENT OF NATURAL RESOURCES

Missouri Facts

Missouri: A Patchwork of Codes

Due to its history of strong local government, **Missouri does not have a mandatory statewide energy code**, however all local jurisdictions except class III counties have the right to adopt an energy code. As expected, this system creates a sometimes confusing patchwork of different codes throughout the state.

Regardless of the system in place, the bottom line is that **many jurisdictions in Missouri still don't have an energy code**—meaning that many residents do not receive the benefits of energy-efficient construction.



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Missouri Facts

Energy Costs

\$20 billion

Amount spent annually on energy in Missouri.

95%

Percentage of primary energy imported from other states.

22%

The rise in the cost of residential electricity, 2004 to 2009.¹

Missouri residents spend billions every year importing energy from other states and abroad. Energy codes can help the state retain some of these dollars and improve Missouri's economy.

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Missouri Facts

Statewide Savings

\$318 million

Annual energy savings by 2030.

26 trillion

Btu of energy avoided annually by 2030.

1.4 million

Metric tons of CO₂ prevented annually by 2030.³

By adopting and enforcing the 2009 IECC starting in 2011, Missouri municipalities and counties would **significantly improve the state's economy and environment** now and into the future.

ENERGIZE MISSOURI

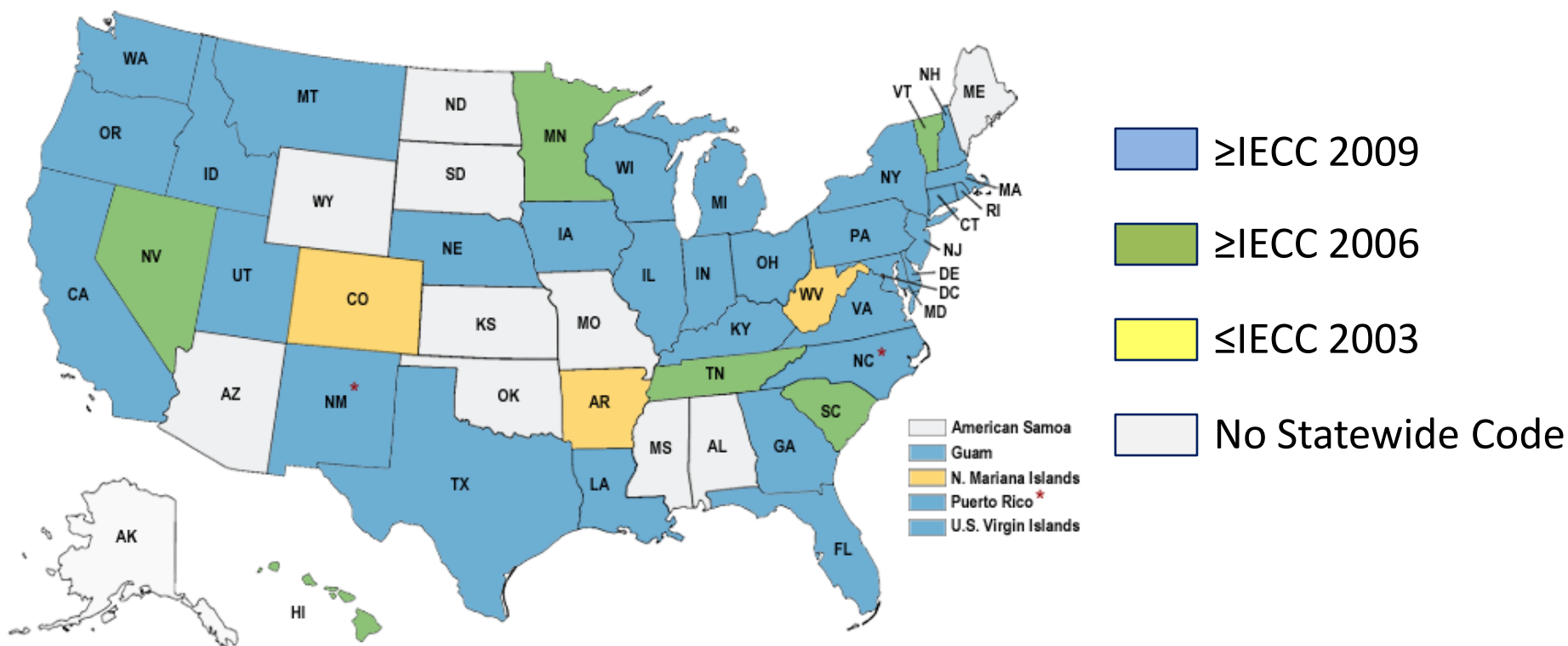
MISSOURI DEPARTMENT OF NATURAL RESOURCES

Topic 1

Overview of Best Practices and Lessons Learned in Missouri

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Commercial State Energy Code Status (*)

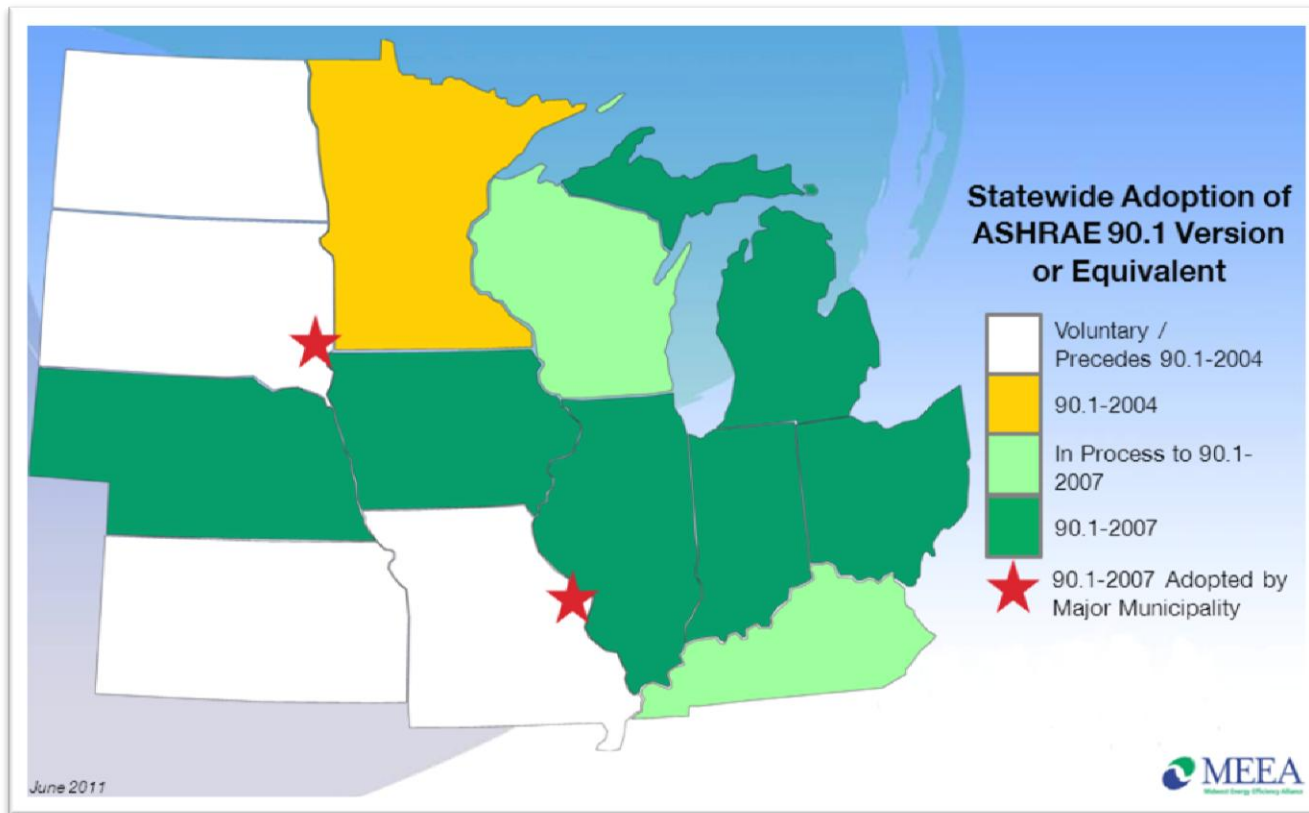


(*) as of November 1, 2011, DOE – Building Energy Codes Program

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Commercial Energy Code - Midwest



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Best Practices Missouri

- Jackson County, Lake St. Louis, Marshall, O'Fallon, and the City of St. Louis ([St. Louis County Public Works](#)) have adopted the 2009 IECC.
- Creve Coeur and Independence are currently in the adoption process.
- St. Charles County and St. Louis County have adopted the 2009 IRC with amendments.

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Best Practices Missouri

Kansas City incorporates energy codes into its broader sustainability effort:

- Created the Environmental Management Commission which advises the city on energy/environmental issues.

Columbia created commissions to advise the city council on energy code issues:

- The Building Construction Codes Commission (BCCC) reviews codes and provides a construction industry perspective.

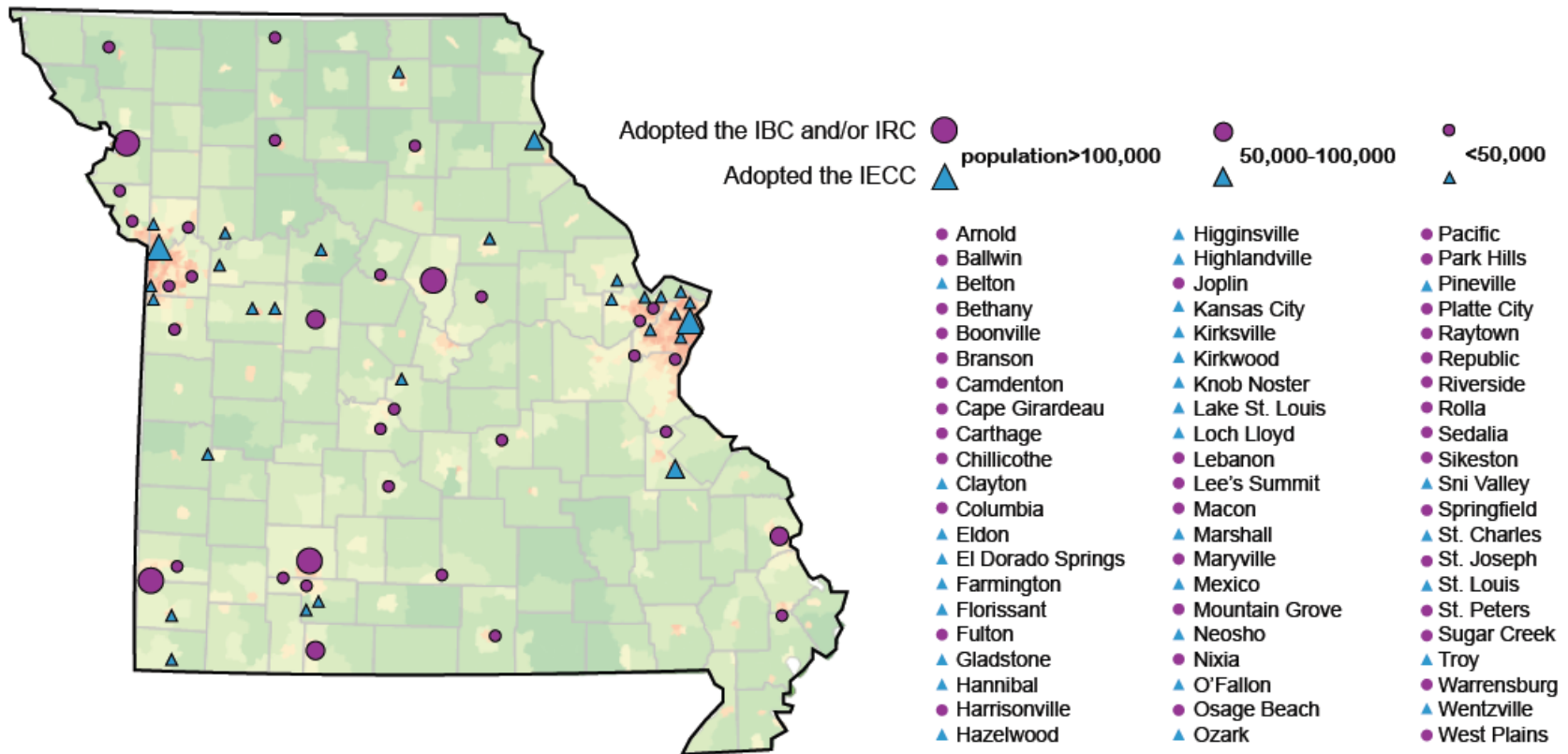
University City

- The University City Green Practices Committee provides input into energy code adoption efforts.

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Local Jurisdiction – Adoption Status



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Topic 2

Commercial Compliance Approaches and their Corresponding Tools

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Different compliance paths

- Prescriptive compliance
- Trade-off*
- Total building performance

*The 2009 International Energy Conservation Code (IECC) contains a U-factor alternative (Section 502.1.2).

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Total Building Performance Approach

Samples of performance software available are listed in the

- [Building Energy Software Tools Directory](http://apps1.eere.energy.gov/buildings/tools_directory/),
http://apps1.eere.energy.gov/buildings/tools_directory/

and on the

- [Building Technologies Program website](http://www1.eere.energy.gov/buildings/),
<http://www1.eere.energy.gov/buildings/>

eQuest is a software that can do an energy analysis.

- <http://doe2.com/equest/>

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

More Resources

- <http://www.ashrae.org/technology/page/121>
- <http://www.iccsafe.org/cs/Pages/opinions.aspx>)
- <http://www.energycodes.gov/help/>

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance for additions or alterations

- One of the keys to showing compliance for additions and alterations is to remember you are only considering the new space, or the new walls, etc.
- You have the option of showing compliance for the entire space, but this is not necessary or typical.

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance for additions or alterations

Using COMcheck&trade, you will indicate "addition" or "alteration" on the project information tab, and need to enter the following information, as it applies to your project:

- Ceiling – gross area (ft²) and insulation R-value of new ceiling
- Exterior walls – gross area (ft²) of new exterior walls and insulation R-value (any existing exterior wall(s) that will become interior wall(s) once the addition is built are not be entered as part of the addition wall area)
- Windows/Doors – gross area (ft²) of windows and/or doors with U-factor from NFRC label or default table in the help section of COMcheck™
- Floor – gross area (ft²) of addition and insulation R-value. If the floor is a slab, the length of the exterior slab edge should be entered in linear feet

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance for Remodels and Alterations

- COMcheck will calculate compliance for your project as you define it. For example, if your project is a tenant improvement with new interior lighting, new exterior lighting and mechanical, you would not need to fill in the envelope tab.
- Conversely, if your project is new construction of an unoccupied commercial shell and there is no interior lighting or mechanical system, you would not fill out those tabs.

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Common Questions

- Please explain how to use different wattage luminaire and comply with code?
- How do I create an energy code compliance report to get my building permit?
- Where can I get a copy of the energy code?

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Common Questions

What are the minimum insulation and window requirements for my building?

My project has both business and homes, is it residential or commercial?

Do the last IECC versions reference the ASHRAE Standards in such a way as to require the commissioning work described in them?

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

State-Level Technical Assistance

Over the years, DOE's Building Energy Codes Program has provided the following types of assistance to state energy organizations:

Technical analysis of residential and commercial codes, including:

- Analysis of energy savings associated with adoption of new codes
- Analysis of first cost impacts and cost-effectiveness associated with adoption of new codes
- Comparative analysis of future code options
- Suggested language for modification of national model codes for state-specific issues

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

State-Level Technical Assistance

- **Training on residential and commercial codes**
Development of customized training materials for state codes
Web-based or in-person training on the national model codes and state codes
- **Software in support of residential and commercial codes**
State-specific energy codes in [REScheck](#)
State-specific energy codes in [COMcheck](#)
- In addition, DOE's BECP has acquired databases of residential and commercial construction volume by state and county. BECP can prepare a number of summary products from these databases for state use related to energy codes.

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

State-Level Technical Assistance

Funding to provide no-cost technical assistance is limited. In assessing each request, the following issues will be taken into consideration:

- Impact, current codes, population, construction start
- States vs Localities
- Nationwide 70% adoption
- State Wide 90% Compliance

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

State-Level Technical Assistance

Status of State-Level Technical Assistance Requests

http://www.energycodes.gov/states/open_requests.stm

Missouri

(City of Kansas City) 08/10 Analyze savings between the 2006 IECC and 2009 IECC and the 2006 IECC and 2012 IECC. - *In Progress*

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Building Energy Codes Assistance for States	Status of State Energy Codes	Check on the current code status of any U.S. state or territory using BECP's interactive map tool. Also find links to state specific portions of BECP's recent nationwide analysis reports, state-level energy official contact information, and many other details.	www.energycodes.gov/states
	Technical Assistance to States	BECP provides specialized technical assistance to the states in the form of economic analysis, code comparisons, webcast training, and compliance material development requested by states to help them adopt, upgrade, implement, and enforce their building energy codes.	http://www.energycodes.gov/states/techAssist.stm
	State Compliance Assistance	BECP has developed an approach states can use for measuring compliance with building energy codes.	http://www.energycodes.gov/arra/compliance_evaluation.stm
No-cost Compliance Tools	Residential Code Compliance Software	REScheck™ and REScheck-Web™ 	http://www.energycodes.gov/software.stm
	Commercial Code Compliance Software	COMcheck™ and COMcheck-Web™ 	
Training	Building Energy Codes University (BECU)	To help stakeholders broaden and deepen their knowledge of building energy codes, BECP is collecting its diverse training resources in an extensive Building Energy Codes University (BECU) that features webcasts, training videos, self-paced online courses, presentations, and other BECP materials and tools.	www.energycodes.gov/training
Resource Center	Building Energy Codes Knowledge Base	This knowledge base provides a variety of different media types, including articles, graphics, online tools, presentations, and videos that anyone can use to create their own training and presentations.	http://resourcecenter.pnl.gov/
Advocacy	The Building Codes Assistance Project (BCAP)	BCAP is an initiative of the Alliance to Save Energy, the American Council for an Energy-Efficient Economy, and the Natural Resource Defense Council that provides states with code advocacy assistance on behalf of DOE.	www.bcapi-energy.org

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

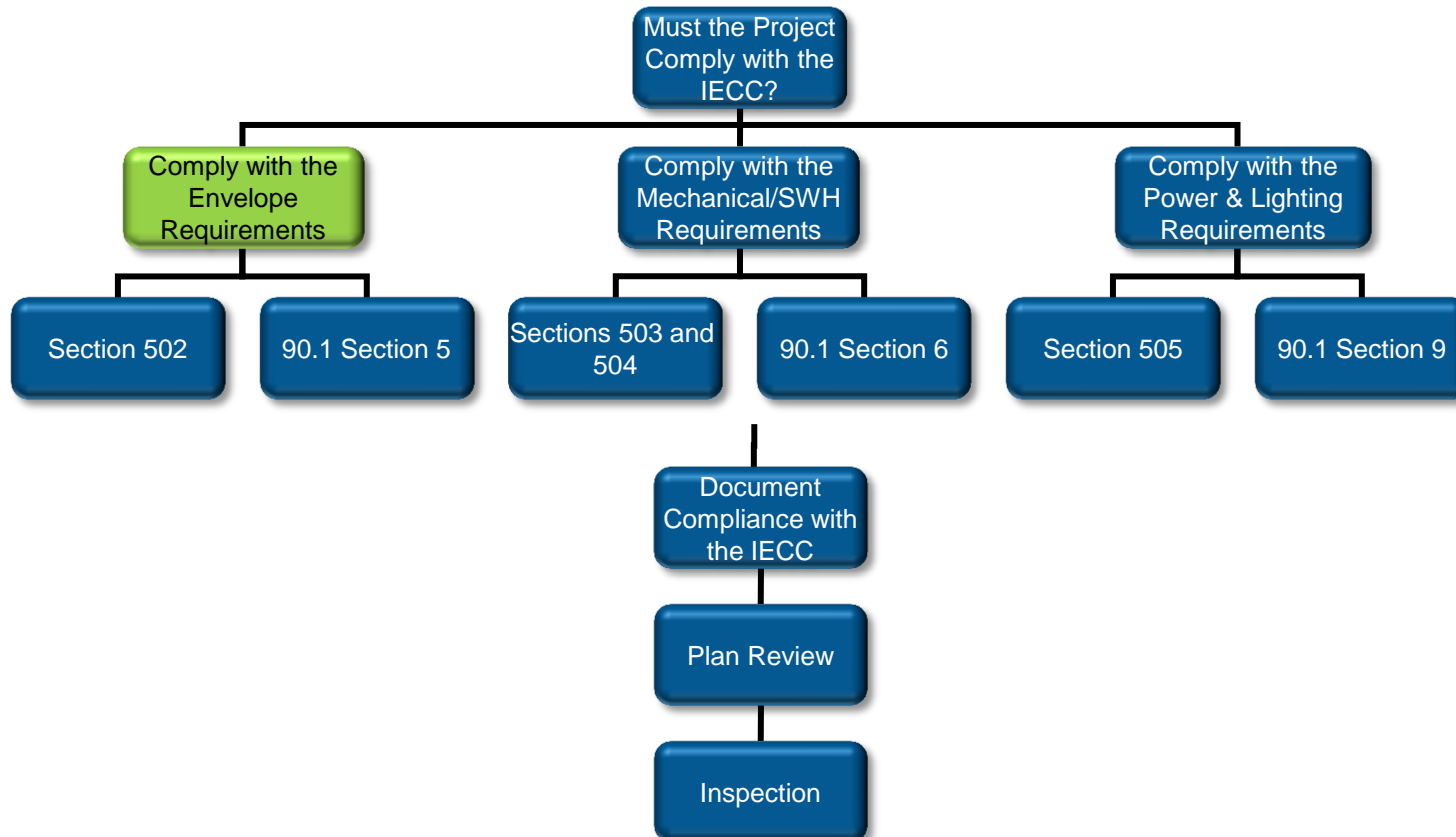
Topic 3

Overview of the Requirements of Commercial Envelope, Lighting and Mechanical Provisions of the 2009 IECC

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Envelope



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

What is the Building Thermal Envelope?

- Roof/Ceiling Assembly
- Wall Assembly
- Vertical Fenestration and Skylights
- Floor Assembly
- Slab Edge
- Below Grade Wall Assembly

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floor, roof, and any other building element that enclose *conditioned space*. This boundary also includes the boundary between *conditioned space* and any exempt or unconditioned space.

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

What are My Options for Complying with the IECC?

- Chapter 5 of the IECC General Prescriptive Approach
- Use for $\leq 40\%$ of gross wall area in vertical fenestration
- Use for $\leq 3\%$ of gross roof area in skylights
- Section 506 Total Building Performance Approach
- ASHRAE/IESNA Standard 90.1-2007

Section 501.2 “Application” requires 90.1 to be used in its entirety (Envelope, Lighting, Mechanical) if used as an alternate compliance path



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance with CH 5 Prescriptive Approach

TABLE 502.2(1)
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above deck	R-15ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci
Metal buildings (with R-5 thermal blocks ^b)	R-19	R-19	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-19	R-13 + R-13	R-19	R-13 + R-13	R-19	R-13 + R-19	R-19	R-13 + R-19	R-19 + R-10	R-11 + R-19	R-19 + R-10
Attic and other	R-30	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49
Walls, Above Grade																
Mass	NR	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci ^c	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building ^b	R-16	R-16	R-16	R-16	R-19	R-19	R-19	R-19	R-13 + R-5.6ci	R-13 + R-5.6ci	R-13 + R-5.6ci	R-13 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci
Metal framed	R-13	R-13	R-13	R-13 + 7.5ci	R-13 + R-3.8ci	R-13 + R-7.5ci	R-13 + 7.5	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5ci	R-13 + R-18.8ci
Wood framed and other	R-13	R-13	R-13	R-13	R-13	R-13	R-13	R-13 + R-3.8ci	R-13 + R-3.8ci	R-13 + 3.8	R-13 + 7.5	R-13 + R-7.5	R-13 + R-7.5ci	R-13 + 7.5ci	R-13 + R-15.6ci	R-13 + 15.6ci
Walls, Below Grade																
Below grade wall ^d	NR	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	NR	R-7.5ci	R-7.5ci	R-10ci	R-7.5ci	R-12.5ci
Floors																
Mass	NR	NR	R-6.3ci	R-8.3ci	R-6.3ci	R-8.3ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-14.6ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/framing Steel(wood)	NR	NR	R-19	R-30	R-19	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^e	R-30	R-30 ^e	R-30 ^e	R-30 ^e
Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below	NR	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below
Heated slabs	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below	R-20 for 24 in. below	R-20 for 48 in. below	R-20 for 48 in. below	R-20 for 48 in. below
Opaque doors																
Swinging	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.70	U – 0.50	U – 0.50	U – 0.50	U – 0.50	U – 0.50
Roll-up or sliding	U – 1.45	U – 1.45	U – 1.45	U – 1.45	U – 1.45	U – 1.45	U – 0.50	U – 0.50	U – 0.50	U – 0.50	U – 0.50	U – 0.50	U – 0.50	U – 0.50	U – 0.50	U – 0.50

For SI: 1 inch = 25.4 mm.

ci = Continuous insulation. NR = No requirement.

a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2(2)].

b. Assembly descriptions can be found in Table 502.2(2).

c. R-5.7 ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.04 Btu-in./ft²·F.

d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.

e. Steel floor joist systems shall be R-38.

CLIMATE ZONE	4		5 AND	
	EXCEPT MARINE		MARINE 4	
	All other	Group R	All other	Group R
Roofs				
Insulation entirely above deck	U-0.048	U-0.048	U-0.048	U-0.048
Metal buildings	U-0.055	U-0.055	U-0.055	U-0.055
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027
Walls, Above Grade				
Mass	U-0.104	U-0.090	U-0.090	U-0.080
Metal building	U-0.084	U-0.084	U-0.069	U-0.069
Metal framed	U-0.064	U-0.064	U-0.064	U-0.064
Wood framed and other	U-0.089	U-0.064	U-0.064	U-0.051
Walls, Below Grade				
Below-grade wall ^a	C-1.140	C-0.119	C-0.119	C-0.119
Floors				
Mass	U-0.087	U-0.074	U-0.074	U-0.064
Joist/Framing	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-Grade Floors				
Unheated slabs	F-0.730	F-0.540	F-0.730	F-0.540
Heated slabs	F-0.860	F-0.860	F-0.860	F-0.860



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Changes to Tables 502.1.2 and 502.2(1)

- Table now separated by occupancy type
- Group R occupancies use “Group R” column
- Non-Group R occupancies use “All other” column

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance with Chapter 5 Prescriptive Approach

TABLE 502.2(2)
BUILDING ENVELOPE REQUIREMENTS—OPAQUE ASSEMBLIES

ROOFS	DESCRIPTION	REFERENCE
R-19	Standing seam roof with single fiberglass insulation layer. This construction is R-19 faced fiberglass insulation batts draped perpendicular over the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
R-13 + R-13 R-13 + R-19	Standing seam roof with two fiberglass insulation layers. The first R-value is for faced fiberglass insulation batts draped over purlins. The second R-value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
R-11 + R-19 FC	Filled cavity fiberglass insulation. A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel, between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
WALLS		
R-16, R-19	Single fiberglass insulation layer. The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"
R-13 + R-5.6 ci R-19 + R-5.6 ci	The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Roof R-Value (502.2.1) / U-Factor (502.1.2)

Roof R-values and U-factor requirements are based on assembly type / insulation placement

- Construction Roofs
- Metal buildings
- Attic and other

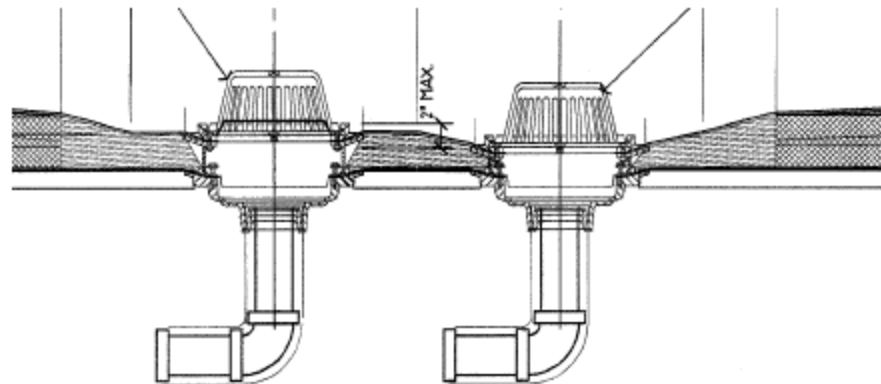


ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Roof R-Value – Insulation Completely Above Deck

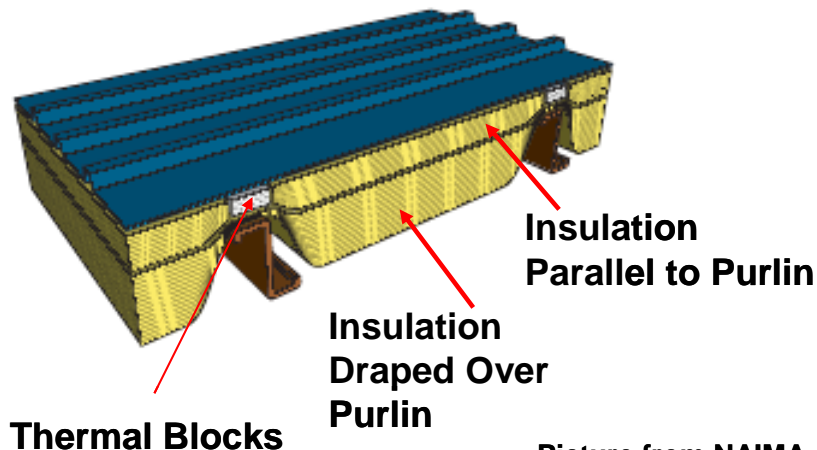
- Insulation considered continuous (*CI*)
- Insulation thickness can vary $\leq 1"$ and area weighted U-factor meets the requirements of Table 502.2(1)



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Roof R-Value – Metal Buildings



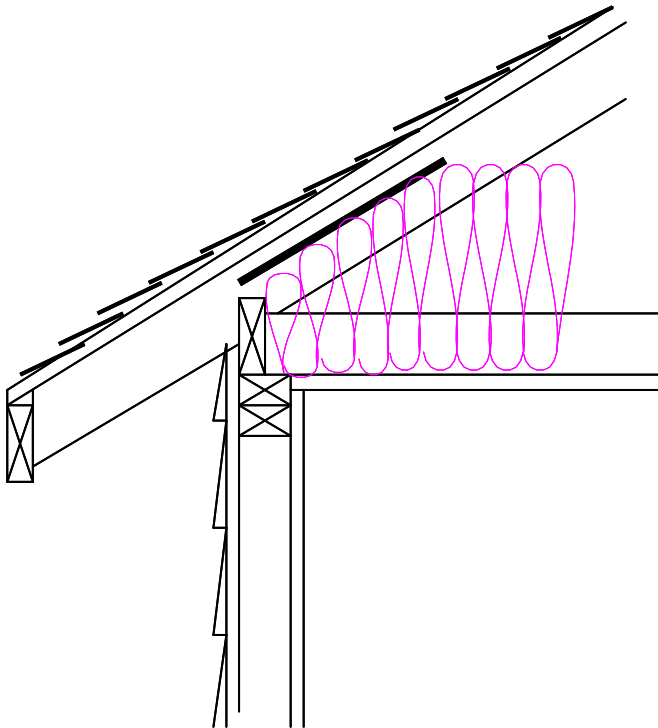
Picture from NAIMA

- R-5 thermal blocks required on all metal buildings or must use U-factor Compliance Method
- Climate Zones 2-8 require two layers of insulation
- CZ 2-5 and marine R: R-13+R-13
- Example (R-13+R-19):
- R-13 draped perpendicularly to the purlins
- R-19 running parallel to the purlins supported by the R-13

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Roof R-Value – Ceilings with Attic Spaces



- Install insulation between framing
- R-37 in most CZ 4 and 5

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Wall R-Value – Mass Walls

- Walls weighing at least 35 lbs/ft² of wall surface area, or
- 25 lbs/ft² of wall surface area if material weight is $\leq 120 \text{ lb/ft}^3$



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Wall R-Value – Wood, Metal Frame, and Other

- Cavity insulation or cavity plus continuous (CI)
- Continuous insulation not broken up by framing members e.g. rigid board insulation

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Metal Building Walls [Table 502.2(2)]



Picture from NAIMA

Climate Zone	R-Value
1-2	R-16
3-4 except Marine	R-19
Marine 4 – 6	R-13+R-5.6ci
7-8	R-19+R-5.6ci

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Below Grade Walls (502.2.4)

- What is a below grade wall?
- Basement or first-story walls $\geq 85\%$ below grade
- Insulation must extend down 10 ft from the outside finished grade level or to the level of the floor, whichever is less

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Floors Over Outdoor Air or Unconditioned Space (502.2.5)



- Joist/Framing (Steel/Wood)
- Insulation installed between framing
- Mass Floors
- Materials weighing 35 lbs/ft², or
- 25 lbs/ft² if material weight is \leq 120 lbs/ft³

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Slab-on-Grade Floors (502.2.6)

- Unheated slab – insulation required in Climate Zones 4-8
- Heated slabs – insulation required in all Climate Zones

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Compliance with Chapter 5 Prescriptive Approach

TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration (40% maximum of above-grade wall)								
U-factor								
Framing materials other than metal with or without metal reinforcement or cladding								
U-factor	1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35
Metal framing with or without thermal break								
Curtain wall/storefront U-factor	1.0	0.70	0.60	0.50	0.45	0.45	0.40	0.40
Entrance door U-factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All other U-factor ^a	1.20	0.75	0.65	0.55	0.55	0.55	0.45	0.45
SHGC-all frame types								
SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
SHGC: 0.25 ≤ PF < 0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
Skylights (3% maximum)								
U-factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.

PF = Projection factor (see Section 502.3.2).

a. All others includes operable windows, fixed windows and nonentrance doors.

CLIMATE ZONE	4 EXCEPT MARINE	5 AND MARINE 4
Vertical fenestration (40% maximum of above-grade wall)		
U-factor		
Framing materials other than metal with or without metal reinforcement or cladding		
U-factor	0.4	0.35
Metal framing with or without thermal break		
Curtain wall/storefront U-factor	0.5	0.45
Entrance door U-factor	0.85	0.8
All other U-factor ^a	0.55	0.55
SHGC-all frame types		
SHGC: PF < 0.25	0.4	0.4
SHGC: 0.25 ≤ PF < 0.5	NR	NR
SHGC: PF ≥ 0.5	NR	NR
Skylights (3% maximum)		
U-factor	0.6	0.6
SHGC	0.4	0.4

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Vertical Fenestration Requirement (502.3.1)



- Based on above-grade wall area (gross)
- Includes walls between conditioned space and unconditioned space or the great outdoors
- Total fenestration area (includes frame and glazing)

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Fenestration U-Factor (502.3.2)

Framing Materials Other Than Metal
w/ or w/o metal reinforcement or
cladding


- Includes vinyl and wood frame products or other non-metal frames
- Typically manufactured fenestration products



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Fenestration U-Factor (303.1.3)

 National Fenestration Rating Council CERTIFIED	World's Best Window Co.	
	<div>Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider</div>	
ENERGY PERFORMANCE RATINGS		
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient	
0.35	0.32	
ADDITIONAL PERFORMANCE RATINGS		
Visible Transmittance	Air Leakage (U.S./I-P)	
0.51	0.2	
Condensation Resistance	<hr/>	
51		
<small>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult manufacturer's literature for other product performance information. www.nfrc.org</small>		

How Do You Meet the Requirement?

- Fenestration product rating in accordance to NFRC 100
- Labeled and certified by the manufacturer
- Non-NFRC 100 rated fenestration
- Default Glazed Fenestration U-factor Table 102.1.3(1)

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Default U-Factors from Tables 303.1.3(1) and (2)

TABLE 102.1.3(1)
DEFAULT GLAZED FENESTRATION *U*-FACTOR

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

TABLE 102.1.3(2)
DEFAULT DOOR *U*-FACTORS

DOOR TYPE	<i>U</i> -FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

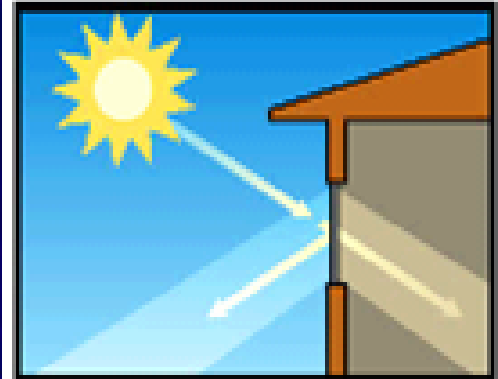
ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Glazed Fenestration SHGC (502.3.2)

What is Solar Heat Gain Coefficient?

“The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation.”



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Fenestration SHGC Requirements – Table 303.1.3(3)

Two Options for Meeting the SHGC Requirements

- Fenestration product rated and labeled to NFRC 200, or
- Select default from Table 303.1.3(3)

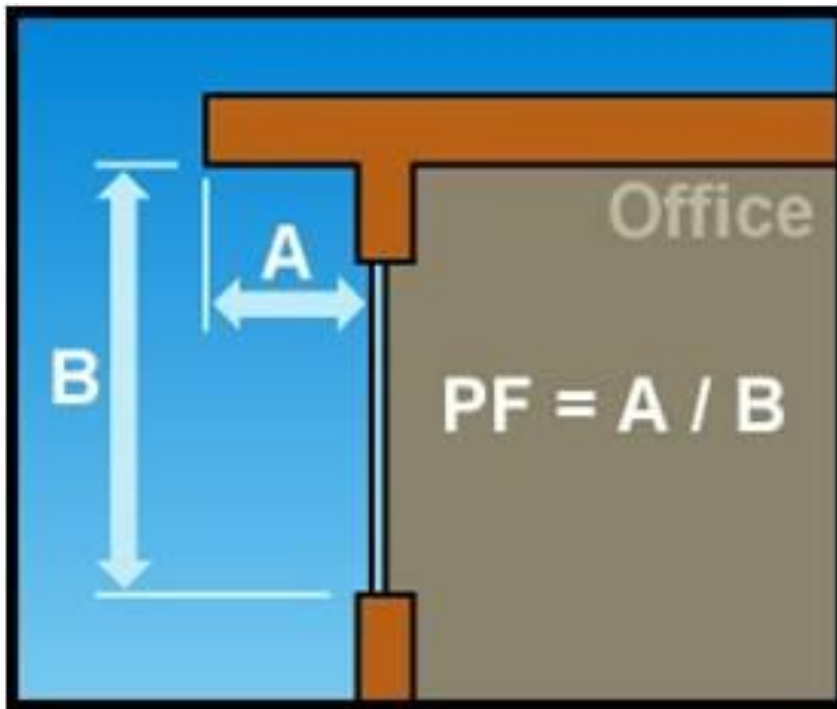
TABLE 102.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC

SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
Clear	Tinted	Clear	Tinted	
0.8	0.7	0.7	0.6	0.6

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Fenestration SHGC Requirements



The Effect of Overhangs on Fenestration SHGC

- Overhangs allow a higher SHGC product to be installed
- Projection factor must be calculated

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Skylight U-Factor / SHGC

- Limited to $\leq 3\%$ of Roof Area
- U-factor and SHGC Based
- NFRC 100 Rating for U-factor or Default Table



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

NFRC 100 Rating for U-factor or Default Table

TABLE 303.1.3(1)
DEFAULT GLAZED FENESTRATION
U-FACTOR

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mandatory Requirements – Sealing of the Building Envelope (502.4.3)

- All penetrations, openings, joints and seams in the building envelope must be sealed. Materials that can be used include:
- Moisture vapor-permeable wrapping material
- Sealing materials spanning joints between dissimilar materials must allow for expansion and contraction



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

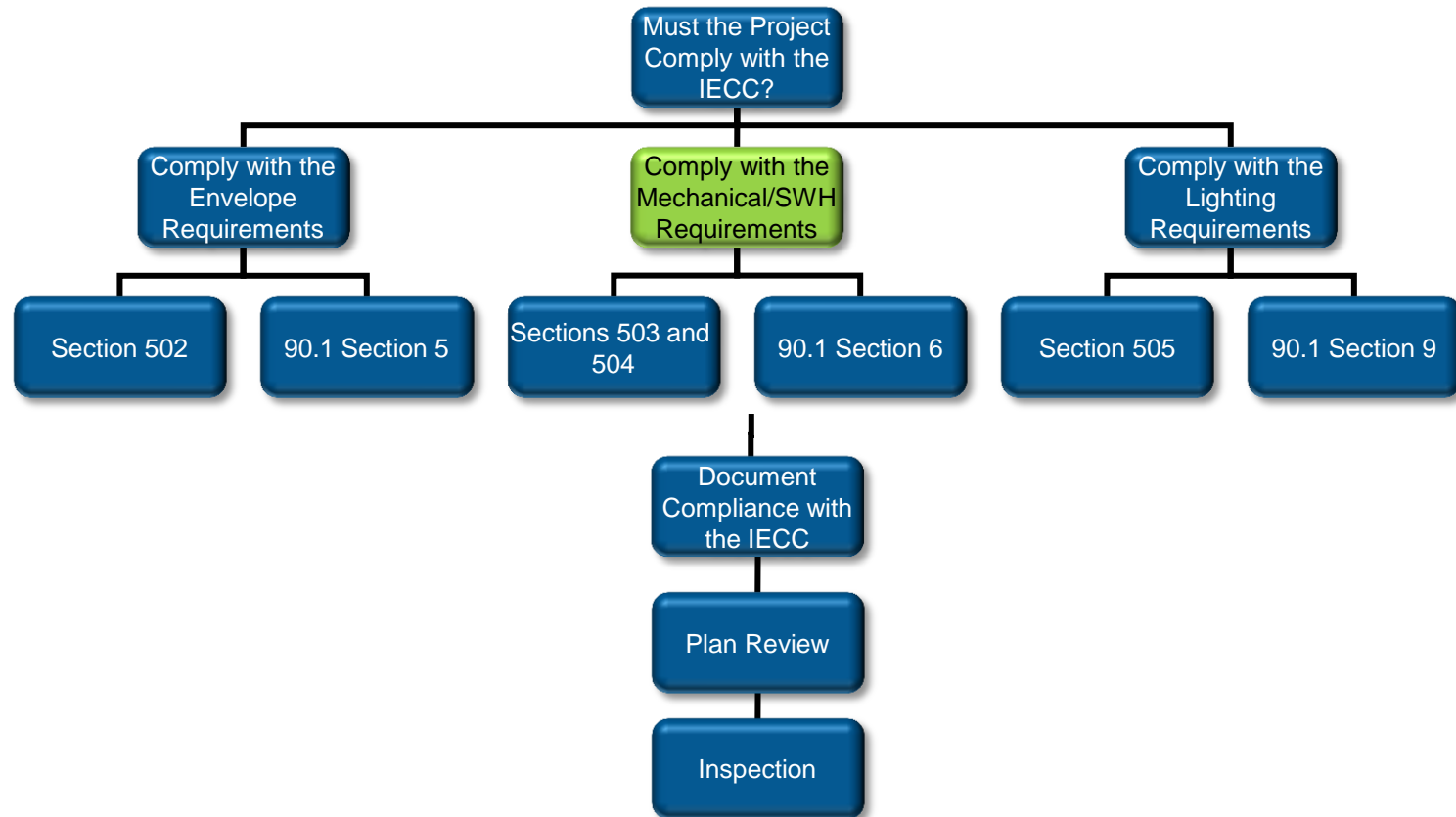
Not Included But Mandatory Requirements

- Opaque Doors (502.2.7)
- Curtain Wall, Storefront Glazing, and Commercial Entrance Doors (502.4.2)
- Hot Gas Bypass (502.4.4)
- Outdoor Intakes and Exhaust Openings (502.4.5)
- Loading Dock Weather Sealing (502.4.6)
- Vestibules (502.4.7)
- Recessed Lighting (502.4.8)

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mechanical



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Section 503 Building Mechanical Systems

Simplified to Include Only Four Sections:

- General (503.1)
- Mandatory Provisions (503.2)
- Simple HVAC Systems and Equipment (503.3)
- Complex HVAC Systems and Equipment (503.4)



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

What Provision of the Code Apply? (503.1)

Mandatory Provisions – Section 503.2 PLUS

- Section 503.3 (Simple Systems) or
- Section 503.4 (Complex Systems)

Simple Versus Complex Systems

- Simple systems
- Unitary or packaged HVAC equipment
- Serves one zone and controlled by a single thermostat

Section 503.3 Simple Systems

Buildings served by unitary or packaged HVAC each serving 1 zone controlled by 1 thermostat.

Two-pipe heating systems serving multiple zones are included if no cooling system is installed [Tables 503.2.3(1) through 503.2.3(5)]

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Simple Versus Complex Systems

- Complex systems
- All equipment not covered under Section 503.3 Simple Systems

Section 503.4 Complex Systems
All buildings served by HVAC systems not covered under 503.3

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mandatory Provisions Applicable to ALL Mech. Systems (503.2)

- HVAC Load Calculations
- Equipment and System Sizing
- HVAC Equipment Performance Requirements
- HVAC System Controls
- Ventilation



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Equipment and System Sizing (503.2.2)

- Output capacity SHALL NOT exceed sizing –
- Select the system which serves the greater load, heating or cooling



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

HVAC Performance (Minimum Efficiency) Requirements (503.2.3)

Table 503.2.3(2)

TABLE 503.2.3(2)
UNITARY AIR CONDITIONERS AND CONDENSING UNITS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY ^b	TEST PROCEDURE ^a
Air cooled, (Cooling mode)	< 65,000 Btu/h ^d	Split system	13.0 SEER	AHRI 210/240
		Single package	13.0 SEER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	Split system and single package	10.1 EER ^e (before Jan 1, 2010) 11.0 EER ^e (as of Jan 1, 2010)	AHRI 340/360
		Split system and single package	9.3 EER ^e (before Jan 1, 2010) 10.6 EER ^e (as of Jan 1, 2010)	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Split system and single package	9.0 EER ^e 9.2 IPLV ^e (before Jan 1, 2010) 9.5 EER ^e 9.2 IPLV ^e (as of Jan 1, 2010)	AHRI 340/360
Through-the-Wall (Air cooled, cooling mode)	< 30,000 Btu/h ^d	Split system	10.9 SEER (before Jan 23, 2010) 12.0 SEER (as of Jan 23, 2010)	AHRI 210/240
		Single package	10.6 SEER (before Jan 23, 2010) 12.0 SEER (as of Jan 23, 2010)	
Water Source (Cooling mode)	< 17,000 Btu/h	86°F entering water	11.2 EER	AHRI/ASHRAE 13256-1
	≥ 17,000 Btu/h and < 135,000 Btu/h	86°F entering water	12.0 EER	AHRI/ASHRAE 13256-1
Groundwater Source (Cooling mode)	< 135,000 Btu/h	59°F entering water	16.2 EER	AHRI/ASHRAE 13256-1
Ground source (Cooling mode)	< 135,000 Btu/h	77°F entering water	13.4 EER	AHRI/ASHRAE 13256-1
Air cooled (Heating mode)	< 65,000 Btu/h ^d (Cooling capacity)	Split system	7.7 HSPF	AHRI 210/240
		Single package	7.7 HSPF	
	≥ 65,000 Btu/h and < 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb Outdoor air	3.2 COP (before Jan 1, 2010) 3.3 COP (as of Jan 1, 2010)	AHRI 340/360
	≥ 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb Outdoor air	3.1 COP (before Jan 1, 2010) 3.2 COP (as of Jan 1, 2010)	

(continued)

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Table 503.2.3(3)

TABLE 503.2.3(3)
PACKAGED TERMINAL AIR CONDITIONERS AND
PACKAGED TERMINAL HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY ^b	TEST PROCEDURE ^c
PTAC (Cooling mode) New construction	All capacities	95°F db outdoor air	$12.5 - (0.213 \cdot \text{Cap}/1000)$ EER	ARI 310/380
PTAC (Cooling mode) Replacements ^c	All capacities	95°F db outdoor air	$10.9 - (0.213 \cdot \text{Cap}/1000)$ EER	
PTHP (Cooling mode) New construction	All capacities	95°F db outdoor air	$12.3 - (0.213 \cdot \text{Cap}/1000)$ EER	
PTHP (Cooling mode) Replacements ^c	All capacities	95°F db outdoor air	$10.8 - (0.213 \cdot \text{Cap}/1000)$ EER	
PTHP (Heating mode) New construction	All capacities	—	$3.2 - (0.026 \cdot \text{Cap}/1000)$ COP	
PTHP (Heating mode) Replacements ^c	All capacities	—	$2.9 - (0.026 \cdot \text{Cap}/1000)$ COP	

For SI: °C = [(°F) - 32] / 1.8, 1 British thermal unit per hour = 0.2931 W

db = dry-bulb temperature, °F

wb = wet-bulb temperature, °F

a. Chapter 6 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

b. Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

c. Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY: NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches (406 mm) high and less than 42 inches (1067 mm) wide.

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

System Controls (503.2.4)

One temperature and humidity (when applicable) controller per zone



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Demand Controlled Ventilation (503.2.5.1)

DCV must be provided for each zone with spaces $> 500 \text{ ft}^2$ and the average occupant load $> 40 \text{ people}/1000 \text{ ft}^2$ of floor area where the HVAC system has:

- An air-side economizer,
- Automatic modulating control of the outdoor air damper,
- A design outdoor airflow $> 3,000 \text{ cfm}$

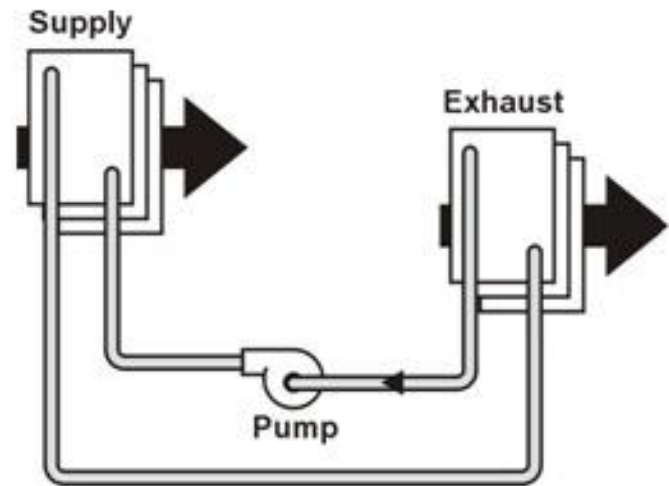
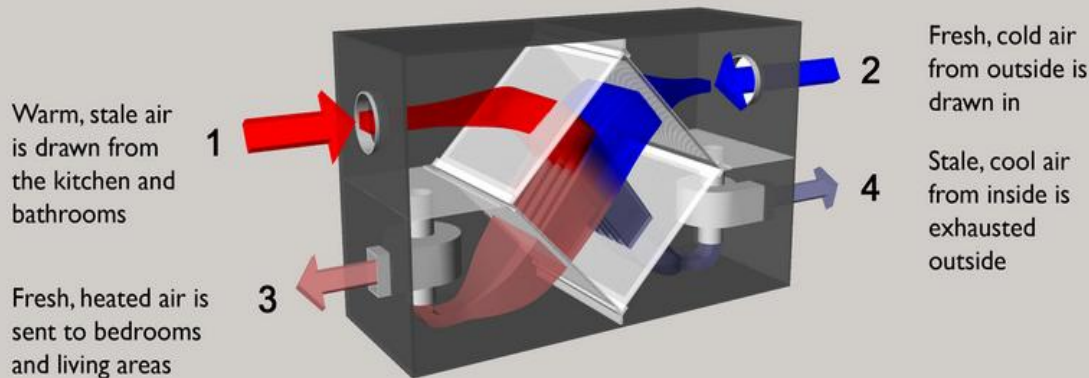
ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Energy Recovery Ventilation Systems (503.2.6)

- Applies to individual fan systems with Design Supply Air capacity $\geq 5,000$ CFM
- Minimum outside air supply of $\geq 70\%$ of design supply air quantity
- Exhaust air recovery efficiency must be $\geq 50\%$

How a Heat Recovery Ventilator Works



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Piping Insulation (503.2.8)

All piping serving heating or cooling system must be insulated in accordance with Table 503.2.8

Minimum Pipe Insulation

FLUID	NOMINAL PIPE DIAMETER (thickness in inches)	
	≤ 1.5"	≥ 1.5"
Steam	1 ½	3
Hot water	1 ½	2
Chilled water, brine or refrigerant	1 ½	1 ½

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

HVAC System

Completion (503.2.9)

- Air System Balancing
- Hydronic System Balancing
- Equipment Capacity and Required Maintenance

Design and Control (503.2.10)

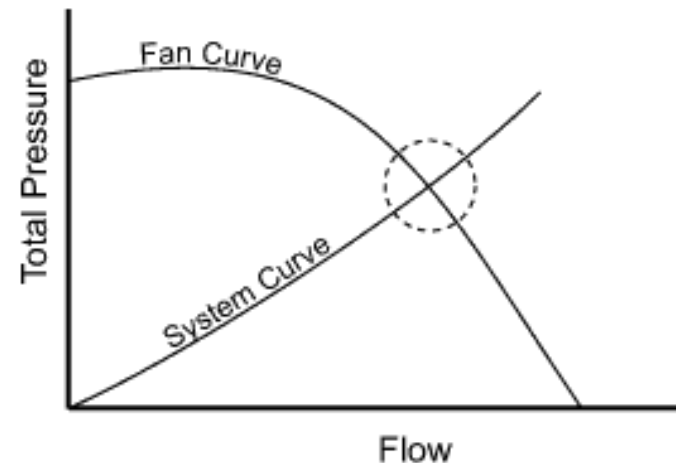
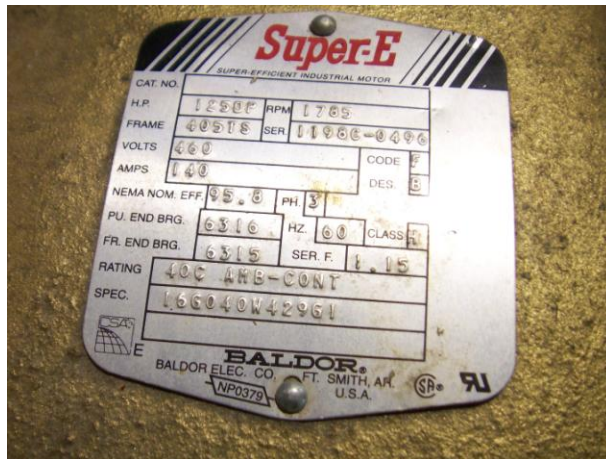
- HVAC systems with total fan system power > 5 hp to meet 503.2.10.1 and 503.2.10.2
- Allowable Fan Floor Horsepower
- Motor Nameplate Horsepower

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Motor Nameplate Horsepower (503.2.10.2)

- Selected fan motor to be no larger than first available motor size greater than bhp
- Fan bhp on design documents



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Simple HVAC Systems and Equipment (503.3)

Unitary or packaged, single zone controlled by a single thermostat in the zone served. Includes:

Simple Systems

- Unitary packaged cooling system
- Split system cooling
- Packaged terminal A/C
- Heat pump cooling
- Unitary packaged heating
- Split system heating
- Packaged terminal heat pump
- Fuel-fired furnace
- Electrical resistance heating
- Two-pipe heating systems w/o cooling
- Economizers

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Economizers (503.3.1)

Table 503.3.1(1)

CLIMATE ZONES	ECONOMIZER REQUIREMENT
1A, 1B, 2A, 7, 8	No requirement
2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B	Economizers on cooling systems $\geq 54,000$ Btu/h ^a

^a The total capacity of all systems without economizers shall not exceed 480,000 Btu/h per building, or 20 percent of its air economizer capacity, whichever is greater

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Economizers (503.3.1)

Trade-off high cooling efficiency for economizer

Table 503.3.1(2)

CLIMATE ZONES	COOLING EQUIPMENT PERFORMANCE IMPROVEMENT (EER OR IPLV)
2B	10% Efficiency Improvement
3B	15% Efficiency Improvement
4B	20% Efficiency Improvement

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Complex HVAC Systems and Equipment (503.4)

Complex Systems

- Packaged VAV reheat
- Built-up VAV reheat
- Built-up single-fan, dual-duct VAV
- Built-up or packaged dual-fan, dual-duct VAV
- Four-pipe fan coil system with central plant
- Hydronic heat pump with central plant
- Any other multiple-zone system
- Hydronic space heating system
- Economizers

This section applies to all HVAC equipment and systems not included in Section 503.3

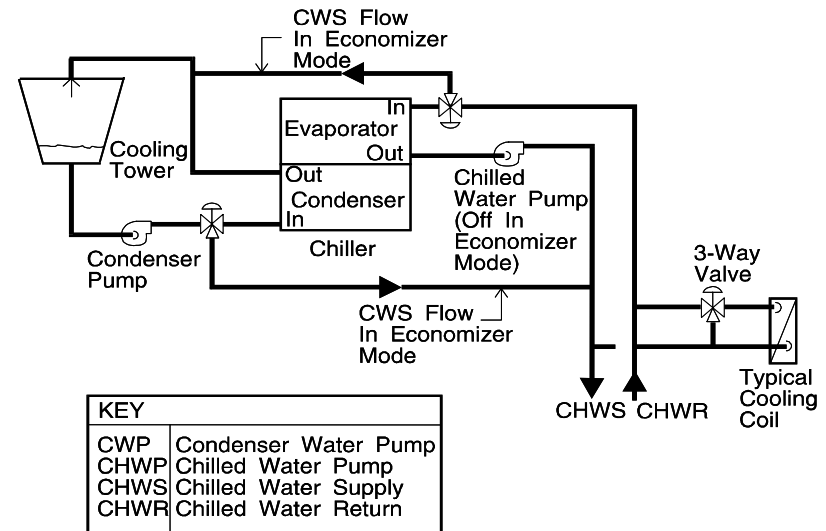
This section applies to all HVAC equipment and systems not included in Section 503.3

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Economizers (503.4.1)

- Air side economizer requirements and equipment performance exceptions in Tables 503.3.1(1) and 503.3.1(2)
- Water side economizer requirements
- Capable of providing 100% of the cooling system load at 50° F dry bulb/ 45°F wet bulb



Variable Air Volume Fan Control (503.4.2)

Individual fans with motors $\geq 10\text{hp}$

- Driven by a mechanical or electrical variable speed drive

OR

- Have controls or devices to result in fan motor demand $\leq 30\%$ of their design wattage at 50% of design airflow when static pressure set point = $1/3$ of the total design static pressure

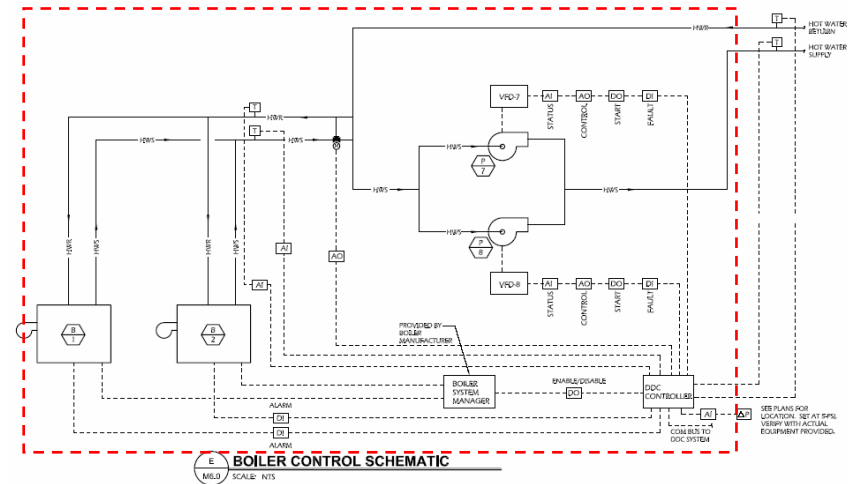
ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Hydronic System Controls (503.4.3)

Limit Reheat/Recool of Fluids

- Multiple-packaged boiler systems designed to deliver conditioned water/steam into common distribution system
- Automatic controls capable of sequencing operation of the boilers



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Hydronic System Controls (503.4.3)

Limit reheat/recool of fluids

- Single boilers > 500,000 Btu/h input design capacity
- Multi-staged or modulating burner required



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Part Load Control (503.4.3.4)

- System $\geq 300,000$ Btu/h
- Automatic Resets for Supply Water Temperature by 25% of Design Supply-to-Return Temperature Differences **or**
- Reduce System Pump Flow by 50% of Design Flow Using
- Multiple Staged Pumps
- Adjustable Speed Drives
- Control Valves with Modulate or Step Down Capabilities

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Heat Rejection Equipment Fan Speed Control (503.4.4)

Each fan powered by a motor ≥ 7.5 hp to have capability to operate that fan at 2/3 of full speed or less

- Have controls to automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device

Exception

- Factory-installed heat rejection devices within HVAC equipment tested and rated in accordance with Tables 503.2.3(6) and 503.2.3(7)

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Multiple Zone System Requirements (503.4.5)

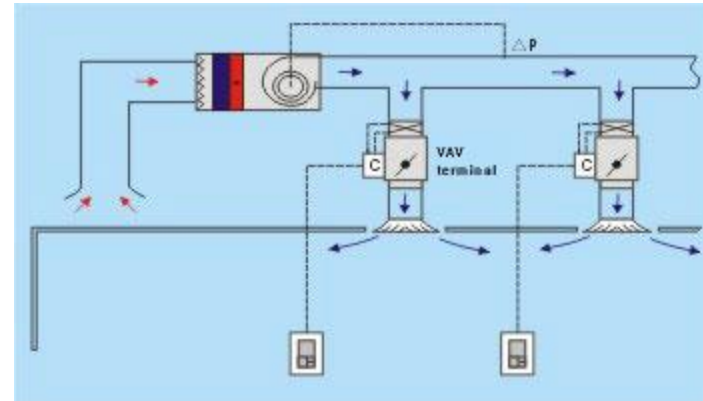
- VAV Systems must be designed and capable of being controlled to reduce the primary air supply to each zone before reheat, recool, or mixing take place
- Options
 - 30% of the maximum supply air to each zone
 - <300 cfm where the maximum flow rate is <10% of total fan system supply airflow rate
 - Minimum ventilation requirements from Chapter 4 of the IMC

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Variable Air Volume System or Zone Exceptions

- Zones with special pressurization or cross-contamination requirements
- Where 75% of reheat energy comes from site-recovered or site-solar energy source
- Zones with special humidity requirements
- Zones with ≤ 300 cfm peak supply and flow rate is $< 10\%$ of total fan system supply airflow rate



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

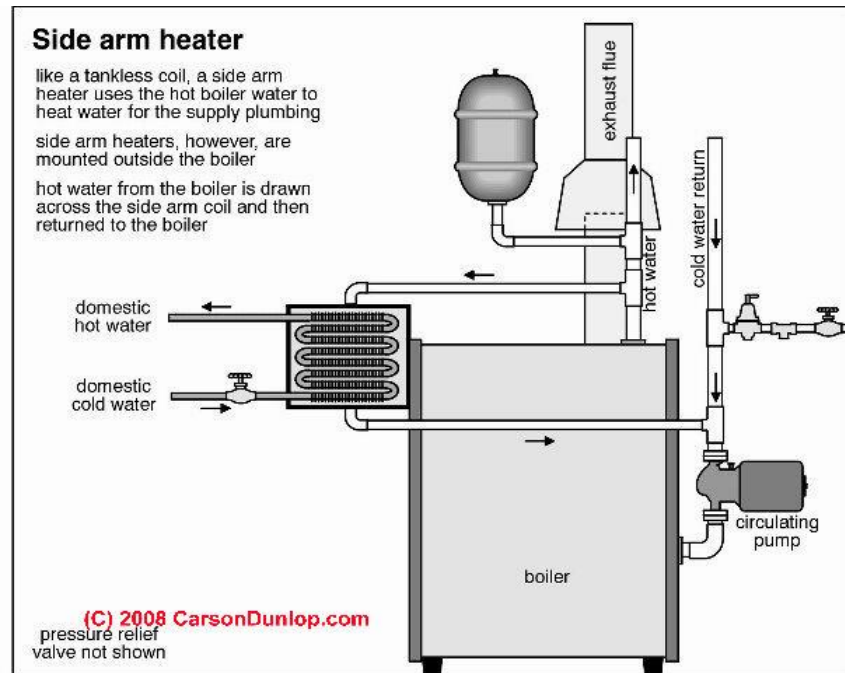
Supply-Air Temperature Reset Controls (503.4.5.4)

- Multiple zone HVAC systems to have controls to automatically reset supply-air temperature in response to building loads or outdoor air temperature
- Controls to be capable of resetting supply air temperature at least 25% of difference between design supply-air temperature and design room air temperature

Heat Recovery for Service Hot Water Heating (503.4.6)

Most effective where water heater loads are large and well distributed throughout the day

- Typical applications: hotels, dorms, prisons, hospitals
- Condenser heat recovery required for heating/reheating of SWH provided:
- Facility operates 24 hours/day



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Section 504 Service Water Heating

- Service water-heating equipment performance efficiency (*504.2*)
- Table 504.2 Minimum Performance of Water-Heating Equipment
- Water Heater Types Covered
- Electric Storage
- Gas and Oil Storage
- Instantaneous Water Heaters – Gas and Oil

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Hot Water System Controls (504.6)

- Ability to turn off circulating hot water pumps and heat trace tape when the system is not in operation
- Automatically or manually



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

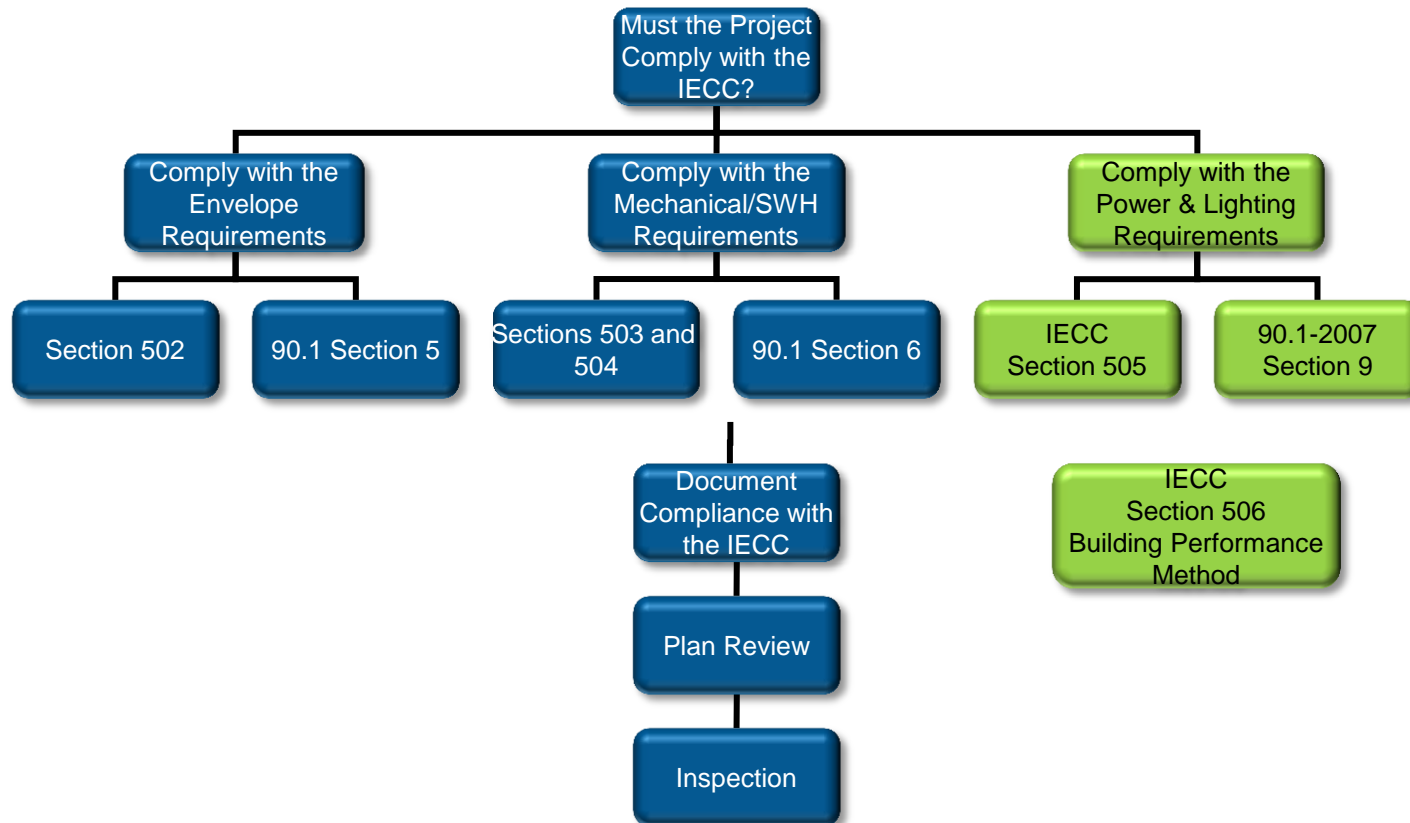
Not Included But Mandatory Requirements

- HVAC Load Calculations (503.2.1)
- Duct and Plenum Insulation and Sealing (503.2.7)
- Heating Outside a Building (503.2.11)
- Hydronic Water Loop Heat Pump Systems (503.4.3.3)
- Pump Isolation (503.4.3.5)
- Single Duct VAV Systems, Terminal Devices (503.4.5.1)
- Pipe Insulation (504.5)
- Pool (504.7)

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Power and Lighting



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

High-Efficacy Lamps

Defined in the 2009 IECC as:

Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy based on lamp wattage

Lamp Wattage	Efficacy
> 40 watts	60 lumens/watt
15-40 watts	50 lumens/watt
< 15 watts	40 lumens/watt

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

What's Covered Under Electrical Power and Lighting Systems Requirements?

- Mandatory Interior Lighting requirements
- Required Controls
- Wattage/Efficiency Limits
- Interior Lighting Power Allowances (watts/ft²)



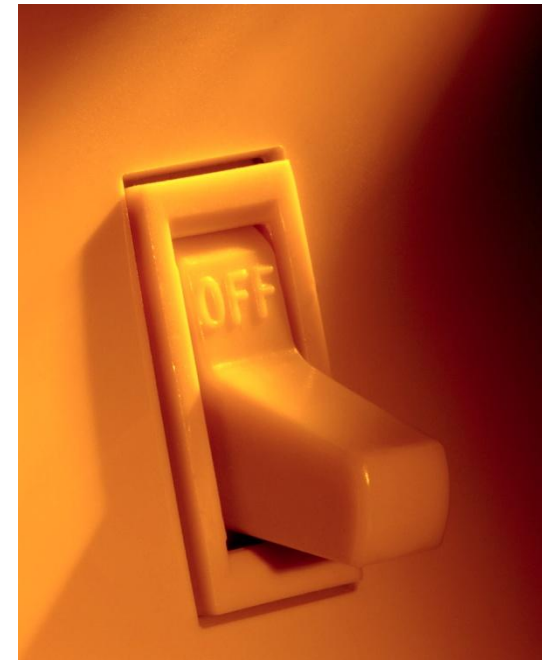
ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Interior Lighting Control (505.2): Basic Control

Independent Lighting Control required for each space surrounded by floor-to-ceiling partitions

- Must be located in the space served,
- or -
- Switched from a remote location
- Must have indicator that identifies the lights served and their status (off or on)



Intent: Allow occupants to control unneeded lighting!

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Interior Lighting Control: Light Reduction

- Light Reduction Controls must allow the occupant to reduce connected lighting
- By at least 50%
- In a reasonably uniform illumination pattern
- Note: Alternate Standard ASHRAE/IESNA 90.1-2007 does not require Light Reduction Control



Intent: Allow occupants to moderate light levels to save energy!

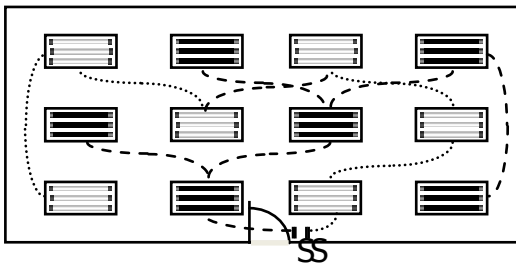
ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

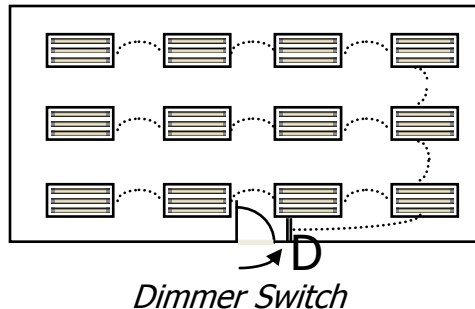
Light Reduction Control Options

- Controlling all lamps or luminaires
- Dual switching of alternate rows of luminaires, alternate luminaires or lamps
- Switching middle lamp luminaires independently from the outer lamps
- Each luminaire or each lamp

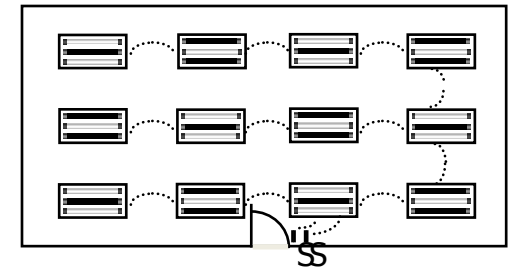
Alternating Luminaries



Dimming



Alternating lamps



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Interior Lighting Control: Automatic Shutoff

Automatic lighting shutoff control device required in all buildings larger than 5,000 ft²

Building Defined:

- “Any structure used or intended for supporting or sheltering any use or occupancy”
- Building area surrounded by exterior walls and fire walls

Exempted spaces

- Sleeping units
- Lighting for patient care
- When an automatic shutoff would endanger occupant safety or security

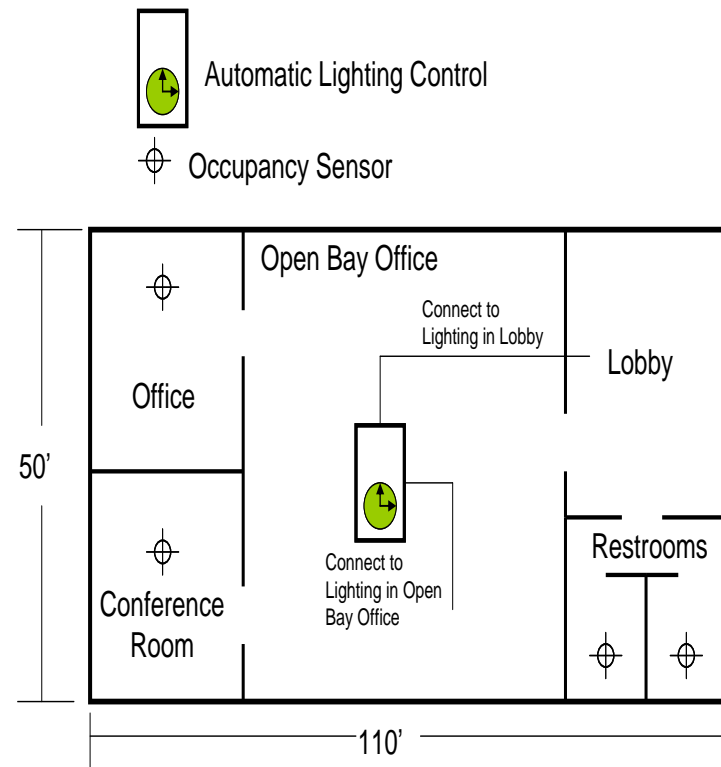
Intent: Eliminate after hours lighting waste!

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Interior Lighting Control: Automatic Shutoff Options

1. Control lights on a scheduled basis (automatic time switch)
 - Time-of-day controller
 - Controls $\leq 25,000$ ft² and not more than one floor, or
2. Occupant sensor
 - Turn lights off within 30 minutes of occupant leaving the space
3. Signal from another control or alarm that indicates the area is unoccupied

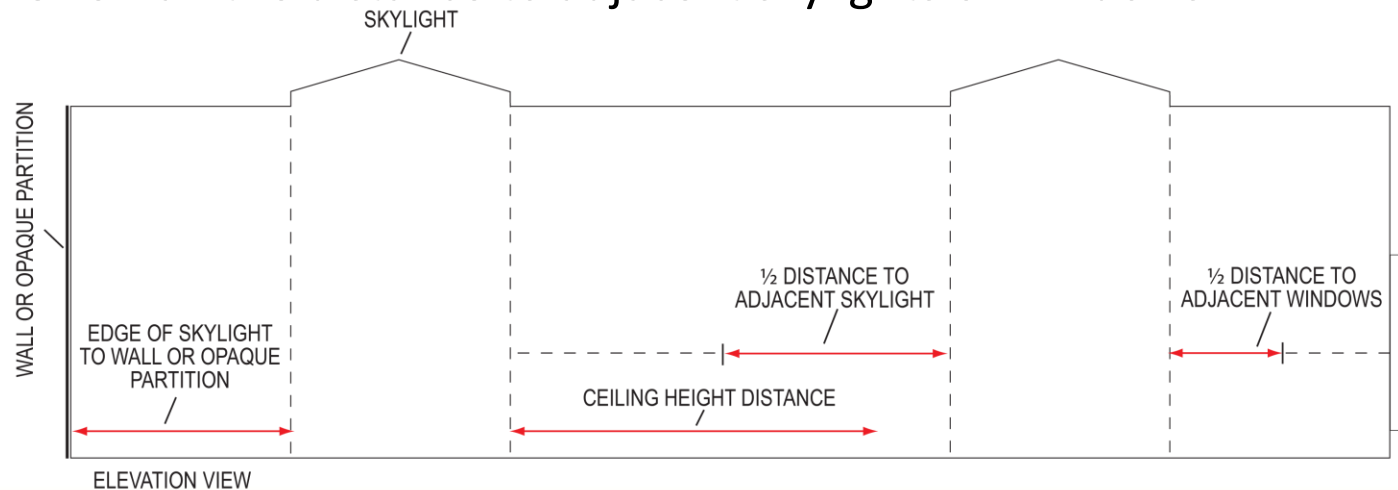


ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Daylight Zone Definition –Under Skylights

- The area under skylights whose horizontal dimension, in each direction, is equal to the skylight dimension plus the smaller of:
 - The floor-to-ceiling height, or
 - The distance to a ceiling height opaque partition, or
 - One-half the distance to adjacent skylights or windows



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Daylight Zone Definition – Adjacent to Vertical Fenestration

- The daylight zone depth is assumed to be 15 feet into the space or to the nearest ceiling height opaque partition, whichever is less
- The daylight zone width is assumed to be:
 - the width of the window plus 2 feet on each side, **or**
 - the window width plus distance to opaque partitions, **or**
 - the window width plus one-half the distance to adjacent skylight or vertical fenestration, whichever is least.

Daylight Zone Control

Daylight zones

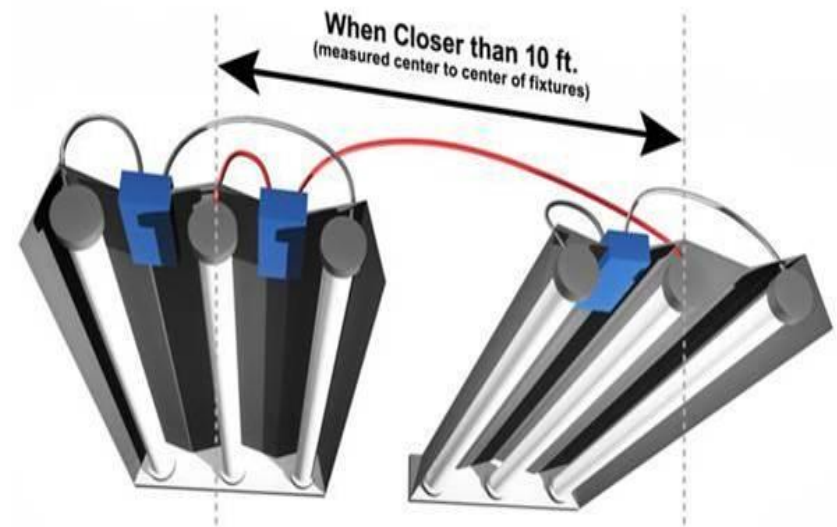
- Must have individual control of the lights independent of general area lighting
- Contiguous daylight zones adjacent to vertical fenestration
- Can be controlled by a single controlling device if the zone doesn't include areas facing more than two adjacent cardinal orientations (i.e., north, east, south, west)
- Daylight zones under skylights > 15 ft from the perimeter must be controlled separately from daylight zones adjacent to vertical fenestration

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Tandem Wiring (505.3)

- Tandem Wiring for all Odd Numbered Lamp Configurations



Intent: Eliminate the use of magnetic ballasts driving single lamps!

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Interior Lighting Power Limits (505.5)

Connected Interior Lighting
Power must not exceed Interior
Lighting Power Allowance

1. Calculate Interior Lighting Power Allowance

Building Area type allowance

Additional allowances

2. Calculate proposed connected lighting power

Wattage calculation “rules”

Exempted lighting

3. Compare values: proposed wattage must be less than or equal to allowed wattage



Intent: Eliminate waste from sloppy lighting design and application!

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Interior Lighting Power Allowances

Table 505.5.2

Building Area Type

Note: Alternate Standard ASHRAE/IESNA 90.1-2007 provides whole building and space-by-space options

LIGHTING POWER DENSITY	
Building Area Type*	(W/R ²)
Automotive Facility	0.9
Convention Center	1.2
Court House	1.2
Dining: Bar Lounge/Leisure	1.3
Dining: Cafeteria/Fast Food	1.4
Dining: Family	1.6
Dormitory	1.0
Exercise Center	1.0
Gymnasium	1.1
Healthcare — clinic	1.0
Hospital	1.2
Hotel	1.0
Library	1.3
Manufacturing Facility	1.3
Motel	1.0
Motion Picture Theater	1.2
Multifamily	0.7
Museum	1.1
Office	1.0
Parking Garage	0.3
Penitentiary	1.0
Performing Arts Theater	1.6
Police/Fire Station	1.0
Post Office	1.1
Religious Building	1.3
Retail*	1.5
School/University	1.2
Sports Arena	1.1
Town Hall	1.1
Transportation	1.0
Warehouse	0.8
Workshop	1.4

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Interior Lighting Power Allowance for Multiple Occupancy Building

How is an allowance determined if the building has more than one Building Area Type?

Example – A building contains the following area types

Museum: 40,000 ft²

Retail: 5,000 ft²

Cafeteria: 10,000 ft²

Use the more specific building area type where more than one area type exists in the building

Sum the individual (lighting power density X area square footage) values for Total Power Allowance

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Multiple Occupancy Building - Example

Museum: 40,000 ft²

at 1.1 W/ft² = 44,000 W

Cafeteria: 10,000 ft²

at 1.4 W/ft² = 14,000 W

Retail: 5,000 ft²

at 1.5 W/ft² = 7,500 W

Total watts allowed = 65,500 W

LIGHTING POWER DENSITY	
Building Area Type ^a	(W/ft ²)
Automotive Facility	0.9
Convention Center	1.2
Court House	1.2
Dining: Bar Lounge/Leisure	1.3
Dining: Cafeteria/Fast Food	1.4
Dining: Family	1.6
Dormitory	1.0
Exercise Center	1.0
Gymnasium	1.1
Healthcare – clinic	1.0
Hospital	1.2
Hotel	1.0
Library	1.3
Manufacturing Facility	1.3
Motel	1.0
Motion Picture Theater	1.2
Multifamily	0.7
Museum	1.1
Office	1.0
Parking Garage	0.3
Penitentiary	1.0
Performing Arts Theater	1.6
Police/Fire Station	1.0
Post Office	1.1
Religious Building	1.3
Retail ^a	1.5
School/University	1.2
Sports Arena	1.1
Town Hall	1.1
Transportation	1.0
Warehouse	0.8
Workshop	1.4

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Proposed Lighting Power Calculation

Sum the wattage of all proposed connected lighting power

This must include all lighting that is part of the design for the space including:

- Overhead lighting
- Task lighting
- Decorative lighting

Note: Wattage must be calculated based on actual power draw...not just nominal lamp rating



Proposed Lighting Calculation: Rules

Lighting wattage must be documented in accordance with Section 505.5.1

Screw lamp holders: maximum labeled wattage of the luminary

Low voltage lighting: transformer wattage

Line voltage track:

1. specified wattage with minimum of 30 W/linear ft **OR**
2. wattage limit of system's circuit breaker **OR**
3. wattage limit of other permanent current limiting devices

Other: manufacturer's rated wattage of lamp and associated ballast

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Exemptions to Proposed Lighting Power Calculation

- Connected power for following not included in calculations:
 - Professional sports arena playing field
 - Sleeping unit lighting
 - Emergency lighting automatically off during normal building operation
 - Lighting in spaces specifically designed for use by occupants with special lighting needs including visual impairment and other medical and age related issues
 - Lighting in interior spaces specifically designated as a registered interior historic landmark
 - Casino gaming areas
- Lighting equipment used for the following exempt if in addition to general lighting and controlled by an independent control device
 - Task lighting for medical and dental procedures
 - Display lighting for exhibits in galleries, museums and monuments



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Exterior Lighting Control Requirements (505.2.4)

- For dusk-to-dawn lighting: astronomical time switch or photocell
- For all other: astronomical time switch OR photocell + time switch
- All time switches must have 10 hour battery backup



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Exterior Efficiency Requirement (505.6.1)

Building grounds lighting luminaires over 100 watts must have source efficacy of at least 60 lumens per watt

Light Source	Typical System Efficacy Range in LPW (varies depending on wattage and lamp type)
Incandescent	10-18
Halogen incandescent	15-20
Compact fluorescent (CFL)	35-60
Linear fluorescent	50-100
Metal halide	50-90

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Exterior Lighting Power Limits (505.6.2)

Connected Exterior Lighting Power must not exceed Exterior Lighting Power Allowance

- Calculate exterior Lighting Power Allowance
 - Lighting power densities by exterior function and by applicable lighting zone
- Calculate proposed connected lighting power
 - Wattage calculation “rules”
 - Exempted lighting
- Compare values: proposed wattage must be less than or equal to allowed wattage

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Exterior Lighting Power Limits (505.6.2)

What areas are covered under exterior lighting allowances?

- **Tradable surfaces**

Common exterior lighted needs that can be traded for other needs.

For example, wattage allowed for parking lot lighting can be “traded” and used for canopy lighting.

- **Nontradable surfaces**

Less common exterior lighted needs that **cannot** be traded for other needs. These applications have more specific security or task illuminance needs.



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Exterior Lighting Zones [Table 505.6.2(1)]

Lighting Zone	Description
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas
3	All other areas
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

Exemptions from Exterior Calculation (505.6.2)

- The following lighting does not need to be included in the proposed lighting calculation:
- Specialized signal, directional, and marker lighting associated with transportation
- Advertising signage or directional signage
- Lighting integral to *equipment* or instrumentation and installed by its *manufacturer*
- Lighting for theatrical purposes, including performance, stage, film production, and video production

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Not Included But Mandatory Requirements

- Interior Lighting Control Sleeping Unit Lighting Control (505.2.3)
- Exit Signs (505.4)
- Additional Retail Lighting Power Allowance (Table 505.5.2)
- Tradable Surfaces (505.6.2)
- NonTradable Surface (505.6.2)
- Electrical Energy Consumption Mandatory Requirements (505.7)

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Topic 4

Commercial Resources, Building Data Collection Checklist and COMcheck

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Building Data Collection Checklists

- To “check on” compliance, the first step is to have a proper checklist. BECP offers evaluation checklists for both residential and commercial buildings, complete with instructions to help evaluators.
- The checklists offer weighted scoring in order to focus on the most important code requirements and help states produce accurate metrics.

BECP Tool:

Download inspection checklists and corresponding instructions at:

www.energycodes.gov/arra/compliance_evaluation.stm

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Building data collection checklists

1. Commercial Building Data Collection Checklist

ANSI/ASHRAE/IESNA Standard 90.1-2007

2. Commercial Building Data Collection Checklist 2009 International Energy Conservation Code

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Software

No-cost, easy-to-use software that will demonstrate compliance.
www.energycodes.gov/software.stm

Desktop Software Tools

Free



Windows version or
Mac version

Web-Based Tools



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Commercial Compliance

Building System

Envelope

Lighting

Mechanical

HVAC

SWH

Mandatory Provisions
(required for most compliance options)

Compliance Options

Prescriptive Option

Trade Off Option

Total Building Performance

Energy Code Compliance

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Info You'll Need

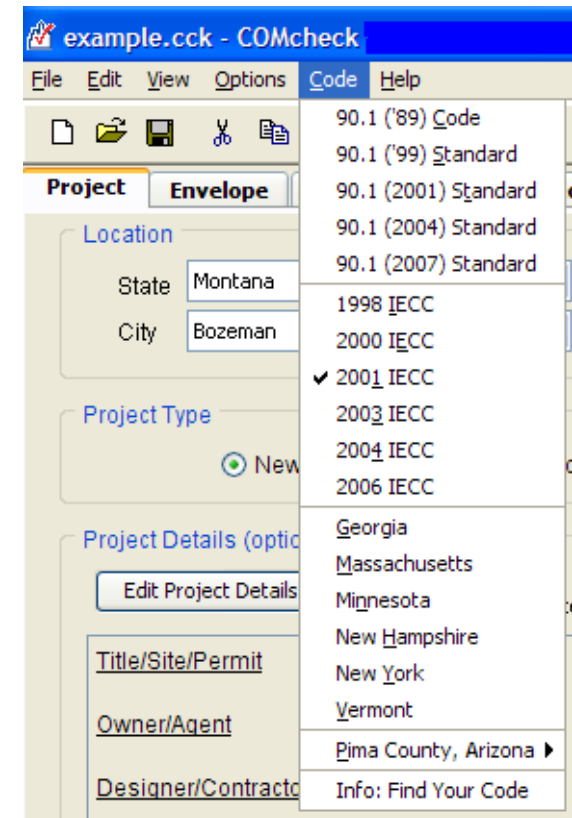
- Basic information about the builder and project
- Area take-offs for exterior walls, fenestration, roof/ceiling, basement walls, floors, etc.
- Insulation R-values, fenestration U-factors, etc.
- Lighting fixture details
- Heating and cooling system details
- Service water heating details

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Appropriate Code

- Energy code applicable to your state/ jurisdiction (Code Menu)
- Status of State Codes
- Default
- Preferences

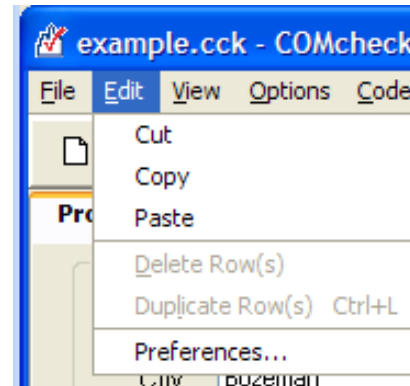


ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Navigation Bar

- Edit Menu
 - General
 - File Options
 - Beyond Code Advisor
 - Version Update Check
 - Project
 - Code/location
 - Envelope
 - Applicant
 - Project Details
- Reports
 - Signatures
 - Email Reports



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Project Information

- Project location
- Project type
- Project details for report (optional)
- Title/Site/Permit
- Owner/Agent
- Designer/Contractor
- Notes

Project Details (optional)

Title/Site/Permit **Owner/Agent** **Designer/Contractor**

Enter the project title, construction site, and permit information.
This information will appear on the compliance certificate.

Title:

Construction Site

Address 1:

Address 2:

City:

State: North Carolina

Zip Code:

Permit

Permit #:

Permit Date:

Notes:

OK Cancel

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Project Screen

Untitled.cck - COMcheck

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical

Location

State: New York

City: Albany

Project Type

☒ New Construction ☐ Addition

Project Details (optional)

Edit Project Details... This information will appear on the compliance certificate.

Title/Site/Permit

Owner/Agent

Designer/Contractor

Notes

Building Use

Add Delete Duplicate

	Building Area Type	Area	W/ft2
1	Click to select category.		

Total Area 0

Exterior Lighting Areas

Add Delete Duplicate Help...

	Exterior Lighting Area	Quantity	Units
1	Click to select area type.		

Envelope TBD Interior Lighting TBD Exterior Lighting TBD

Use the 'View' menu to display mandatory requirements.

Automotive Facility
 Convention Center
 Court House
 Dining: Bar Lounge/Leisure
 Dining: Cafeteria/Fast Food
 Dining: Family
 Dormitory
 Exercise Center
 Gymnasium
 Healthcare-Clinic
 Hospital
 Hotel
 Library
 Manufacturing Facility
 Motel
 Motion Picture Theater
 Multifamily
 Museum
 Office
 Parking Garage
 Penitentiary
 Performing Arts Theater
 Police/Fire Station
 Post Office
 Religious Building
 Retail
 School/University
 Sports Arena
 Town Hall
 Transportation
 Warehouse
 Workshop

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Building Components

- Only components that separate conditioned space from unconditioned space/outside air
- Only use applicable buttons
- Can group “like” components
- Use of “other” assembly type
- Gross area

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Foundations

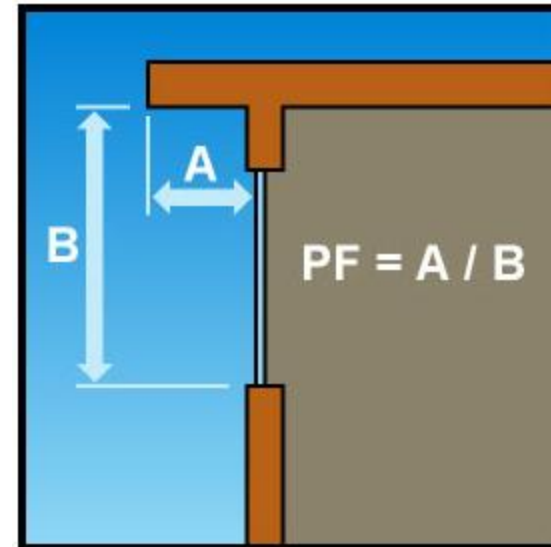
- Basement button – use if
 - basement is conditioned
 - basement walls are insulated
- Floor button – use if
 - separates conditioned from unconditioned space (includes slab-on-grade floor)

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Envelope Screen

- Entries can change based on code and/or location selected
- Assembly types
- *Int. Wall* button
- Projection Factor
- Orientation



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Envelope Results



COMcheck Software Version 3.5.3

Envelope Compliance Certificate

2001 IECC

Report Date: 03/13/09

Data filename: C:\Program Files\Check\COMcheck\353\example.cck

Section 3: Requirements Checklist

Envelope PASSES: Design 0.2% better than code.

Climate-Specific Requirements:

Activity Type(s)	Floor Area
Office	4500
Convention, Conference or Meeting Center	420
Corridor, Restroom, Support Area	1400
Storage, Industrial and Commercial	2520
Industrial Work, < 20 ft Ceiling Height	2700
Lobby - Other	600

Section 3: Requirements Checklist

Envelope PASSES: Design 5% better than code.

Climate-Specific Requirements:

Component Name/Description	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor
Roof 1: Non-Wood Joist/Rafter/Truss	6112	0.0	26.1	0.037	0.050
Skylight 1: Metal Frame, Double Pane, Tinted, SHGC 0.80	112	---	---	0.500	0.050
Exterior Wall 1: Solid Concrete or Masonry <= 8", Furring: Metal	6000	22.0	0.0	0.114	0.072
Door 1: Glass, Clear, SHGC 0.58	42	---	---	0.700	0.520
Window 1: Metal Frame, Double Pane with Low-E, Tinted, SHGC 0.63	1500	---	---	0.600	0.520
Window 2: Metal Frame, Double Pane, Clear, SHGC 0.72	56	---	---	0.700	0.520
Door 2: Overhead	288	---	---	0.140	0.118
Door 3: Solid	40	---	---	0.200	0.118
Interior Wall 2: Metal Frame, 16" o.c.	812	22.0	0.0	0.106	0.118
Basement Wall 1: Solid Concrete or Masonry <= 8", Furring: None, Wall Ht: 12.5, Depth S.G. 7.0	2000	---	10.8	0.082	0.096
Floor 1: Slab-On-Grade: Unheated, Vertical 2 ft	160	---	10.8	---	---

Interior Lighting

- Mandatory requirements
- Interior lighting power requirements
- Complies if total connected power is less than interior lighting power allowance (entire building or partial building)

Proposed
Wattage

\leq

Allowed
Wattage

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Interior Lighting

- LPDs based on Building Use on *Project* screen
- Add fixtures
- Identify exemptions and allowances (if applicable)

	Component	Fixture ID	Fixture Description	Lamp Description/ Wattage Per Lamp	Ballast	Lamps Per Fixture	Number of Fixtures	Fixture Wattage
	Building	Allowed wattage = 17320 Proposed wattage = 12478						
1	Office (4520 sq.ft.)	Allowed wattage = 6780 Proposed wattage = 1976						
2	Incandescent 1	G	Recessed wall washer	Incandescent 150W		1	2	150
3	Incandescent 2	H	Accent track lighting	Incandescent 50W		1	5	50
4	Compact Fluorescent 1	F	Down light, twin tube	Twin Tube 18W	Magnetic	2	31	46
5	Convention, Conference or M	Allowed wattage = 630 Proposed wattage = 3900						
6	T8 / T12 Fluorescent 5	E	8 ft. Industrial, penda...	96" T8 75W	Electronic	2	30	130

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Exemptions and Allowances

CASE STUDY WA.cck - COMcheck 3.9.0 Code: 2009 IECC

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical

Linear Fluorescent Compact Fluorescent HID Incandescent Halogen Track Lighting

Component	Fixture ID	Fixture Description	Lamp Description/ Wattage Per Lamp	Ballast	Lamps Per Fixture	Number of Fixtures	Fixture Wattage	Track Lighting Wattage	Exemption Allowance
Building	Allowed wattage = 20532 Proposed wattage = 18832								
Office (20532 sq.ft.)	Allowed wattage = 20532 Proposed wattage = 18832								
2X4 4 LAMP T8		PARABOLIC TROFFER	24" T8 17W	Electronic	4	174	68		None
2X4 2 LAMP T12		PARABOLIC TROFFER	24" T12U 40W	Magnetic	2	31	70		None
1X4 2 LAMP T12		PARABOLIC TROFFER	48" T12 40W	Magnetic	2	5	70		Exemption
2X2 2 LAMP T12		PRISMATIC TROFFER	24" T12U 40W	Magnetic	2	53	70		Allowance
2X4 2 LAMP T12		PARABOLIC TROFFER	24" T12U 40W	Magnetic	2	70	11		

Interior Lighting Passes: Design 8% better than Code

Envelope +0.2% Interior Lighting +8% Exterior Lighting +3%

Add/move fixtures to an appropriate building use category.

- Advertising/Directional Signage
- Athletic TV Broadcasting
- Casino Gaming
- Display Lighting in Galleries/Museums
- Exit Signs, Safety or Emergency Lighting
- Food Preparation Equipment
- Furniture-mounted Supplemental Task Lighting
- Lighting in Refrigerator/Freezer Cases
- Lighting for Visually Impaired
- Lighting for Medical/Age Related Issues
- Lighting Integral to Equipment
- Lighting Sales or Education
- Medical/Dental Procedure Lighting
- Plant Growth Lighting
- Professional sports arena playing field
- Registered Historical Landmark
- Retail Display Window
- Sleeping Unit Lighting
- Theatrical/Photographic Lighting

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Interior Lighting Results



COMcheck Software Version 3.6.0 Interior Lighting Compliance Certificate

2006 IECC

Section 1: Project Information

Project Type: **New Construction**

Project Title :

Construction Site:

Owner/Agent:

Designer/Contractor:

Section 2: General Information



COMcheck Software Version 3.6.0 Interior Lighting Application Worksheet

2006 IECC

Section 1: Allowed Lighting Power Calculation

A Area Category	B Floor Area (ft ²)	C Allowed Watts / ft ²	D Allowed Watts (B x C)
Office	4520	1	4520
Convention Center	420	1.2	504
Warehouse	2520	0.8	2016

Interior Lighting PASSES: Design 8% better than code.

Warehouse 2520

Section 3: Requirements Checklist

Interior Lighting:

- ☐ 1. Total proposed watts must be less than or equal to total allowed watts.

Allowed Watts	Proposed Watts	Complies
7040	6136	YES

Controls, Switching, and Wiring:

- ☐ 2. Independent controls for each space (switch/occupancy sensor).

Exceptions:

Areas designated as security or emergency areas that must be continuously illuminated.
Lighting in stairways or corridors that are elements of the means of egress.

- ☐ 3. Master switch at entry to hotel/motel guest room.
☐ 4. Individual dwelling units separately metered.
☐ 5. Each space provided with a manual control to provide uniform light reduction by at least 50%.

Exceptions:

Only one luminaire in space.
An occupant-sensing device controls the area.
The area is a corridor, storeroom, restroom, public lobby or sleeping unit.
Areas that use less than 0.5 Watts/sq ft.

- ☐ 6. Automatic lighting shutoff control in buildings larger than 5,000 sq ft.
Exceptions:
Sleeping units, patient care areas; and spaces where automatic shutoff would endanger safety or security.
☐ 7. Photocell/astrometrical time switch on exterior lights.
Exceptions:
Lighting intended for 24 hour use.
☐ 8. Tandem wired one-lamp and three-lamp ballasted luminaires (No single-lamp ballasts).
Exceptions:
Electronic high-frequency ballasts; Luminaires on emergency circuits or with no available pair.

Section 4: Compliance Statement

Fixture ID : Description / Lamp / Wattage per Lamp / Ballast	Lamp/ Fixture	# or Fixtures	Fixture Watt.	(C x U)
Office (4520 sq ft.)				
Incandescent 1: G: Recessed wall washer / Incandescent 150W	1	2	150	300
Incandescent 2: H: Accent track lighting / Incandescent 50W	1	5	50	250
Compact Fluorescent 1: F: Down light, twin tube / Twin Tube 18W / Magnetic	2	31	46	1426
Convention Center (420 sq ft.)				
T8 / T12 Fluorescent 5: E: 8 ft. Industrial, pendant mount / 96" T8 75W / Electronic	2	30	130	3900
Warehouse (2520 sq ft.)				
T8 / T12 Fluorescent 3: C: 4 ft. Wall mount, wrap-around / 48" T8 32W / Electronic	2	4	65	260
Total Proposed Watts =				6136

Section 3: Compliance Calculation

If the Total Allowed Watts minus the Total Proposed Watts is greater than or equal to zero, the building complies.

Total Allowed Watts =	7040
Total Proposed Watts =	6136
Project Compliance =	904

Interior Lighting PASSES: Design 13% better than code.



MISSOURI
DEPARTMENT OF
NATURAL RESOURCES



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Exterior Lighting

- Based on code selected
- Mandatory requirements
- Exemptions

$$\begin{array}{|c|} \hline \text{Total} \\ \text{Connected} \\ \text{Power} \\ \hline \end{array} < \begin{array}{|c|} \hline \text{Ext. Ltg.} \\ \text{Power} \\ \text{Allowance} \\ \hline \end{array}$$

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Exterior Lighting

- Pay attention to Quantity and Units

Tradable

- Common applications where unused power can be traded where needed

Non-Tradable

- Less common applications that cannot be traded

Exterior Lighting Areas

[Help...](#)

	Exterior Lighting Area	Quantity	Units	W/Unit	Tradable
1	Drive-up window	2	window(s)	400	No
2	Main entry/exit	4	ft of door ...	30	Yes
3	Parking area(s)	15000	ft2	0.15	Yes
4	Walkway < 10 feet wide	100	ft of walk...	1.0	Yes

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Exterior Lighting Results



COMcheck Software Version 3.5.3

Exterior Lighting Compliance Certificate

2006 IECC

Report Date: 03/12/09

Data filename: C:\Program Files\Check\COMcheck\353\example.ccx

Section 1: Project Information

Project Type: New Construction

Project Title:

Construction Site:

Owner/Agent:

Designer/Contractor:

Exterior Lighting PASSES: Design 3% better than code.

		Watts / Unit	Watts	Watts (C x D)	Watts
Drive-up window	2 window(s)	400	No	800	960
Main entry/ext	4 ft of door width	30	Yes	120	84
Parking area(s)	15000 sq ft	0.15	Yes	2250	2200
Walkway < 10 feet wide	100 ft of walkway length	1	Yes	100	99
		Total Tradable Watts*	2470	2383	
		Total Allowed Watts**	3270		
		Total Allowed Supplemental Watts**	164		

* Wattage tradeoffs are only allowed between tradable areas/surfaces.
** A supplemental allowance equal to 5% of total allowed wattage may be applied toward compliance of both non-tradable and tradable areas/surfaces.

Section 3: Exterior Lighting Fixture Schedule

Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	A	B	C	D	E
		Lamp / Fixture	# of Fixtures	Fixture Watt.	(C X D)
Drive-up window (2 window(s)): Non-tradable Wattage					
HID 1: Metal Halide 100W / Magneto		1	8	120	960
Main entry/ext (4 ft of door width): Tradable Wattage					
Compact Fluorescent 1: Spiral 42W / Electronic		1	2	42	84
Parking area(s) (15000 sq ft): Tradable Wattage					
HID 2: Metal Halide 100W / Magneto		1	6	440	2200
Walkway < 10 feet wide (100 ft of walkway length): Tradable Wattage					
HID 3: Metal Halide 32W / Electronic		1	3	33	99
		Total Tradable Proposed Watts =		2383	

Section 4: Requirements Checklist

Lighting Wattage:

- ☐ 1. Within each non-tradable area/surface, total proposed watts must be less than or equal to total allowed watts. Across all tradable areas/surfaces, total proposed watts must be less than or equal to total allowed watts.

Compliance: Passes using supplemental allowance watts.

Controls, Switching, and Wiring:



MISSOURI
DEPARTMENT OF
NATURAL RESOURCES



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mechanical Equipment

Works differently than Envelope and Lighting

Enter characteristics of:

- HVAC system
- Plant
- Water heating

Generates a customized list of requirements

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mechanical Report



COMcheck Software Version 3.6.0

Section 5: Compliance Statement

Compliance Statement: The proposed mechanical design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed mechanical systems have been designed to meet the 2009 IECC requirements in COMcheck Version 3.9.0 and to comply with the mandatory requirements in the Requirements Checklist.

Name - Title

Signature

Date

Section 6: Post Construction Compliance Statement

- ☐ HVAC record drawings of the actual installation, system capacities, calibration information, and performance data for each equipment provided to the owner.
- ☐ HVAC O&M documents for all mechanical equipment and system provided to the owner by the mechanical contractor.
- ☐ Written HVAC balancing and operations report provided to the owner.

The above post construction requirements have been completed.

Principal Mechanical Designer-Name

Signature

Date

☐ 1. Newly purchased heating equipment meets the heating efficiency requirements

Generic Requirements: Must be met by all systems to which the requirement is applicable:



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Mandatory Requirements

- Must be met by all buildings
- Included in compliance report(s)
- Viewable in software Help

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Screen Operations

example.cck - COMcheck

File Edit View Options Code Help

Project Envelope Interior Lighting Mechanical

Roof Skylight Ext. Wall Int. Wall Window Door Basement Floor

	Component	Assembly	Construction Details	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor
Building										
1	Roof 1	Non-Wood Joist/Rafter/T...		6112	ft2	0.0	26.1	0.037		
2	Skylight 1	Metal Frame, Double Pane	Glazing: Ti...	112	ft2			0.500	0.80	
3	Exterior Wall 1	Solid Concrete or Masonr...	Furring: M...	6000	ft2	22.0	0.0	0.114		
4	Door 1	Glass	Glazing: Cl...	42	ft2			0.700	0.58	0.00
5	Window 1	Metal Frame, Double Pan...	Glazing: Ti...	1500	ft2			0.600	0.63	0.00
6	Window 2	Metal Frame, Double Pane	Glazing: Cl...	56	ft2			0.700	0.72	0.00
7	Door 2	Overhead		288	ft2			0.140		
8	Door 3	Solid		40	ft2			0.200		
9	Interior Wall 2	Metal Frame, 16" o.c.		812	ft2	22.0	0.0	0.106		
10	Basement Wall 1	Solid Concrete or Masonr...	Furring: N...	2000	ft2		10.8	0.082		
11	Floor 1	Slab-On-Grade/Unheated	Insulation:...	160	ft		10.8			

Envelope PASSES: Design 5% better than Code

Envelope +5% Interior Lighting +28%

Use the 'Options' menu to add or remove orientation and daylighting control factor.

Compliance Bar
Status Bar

ENERGIZE MISSOURI

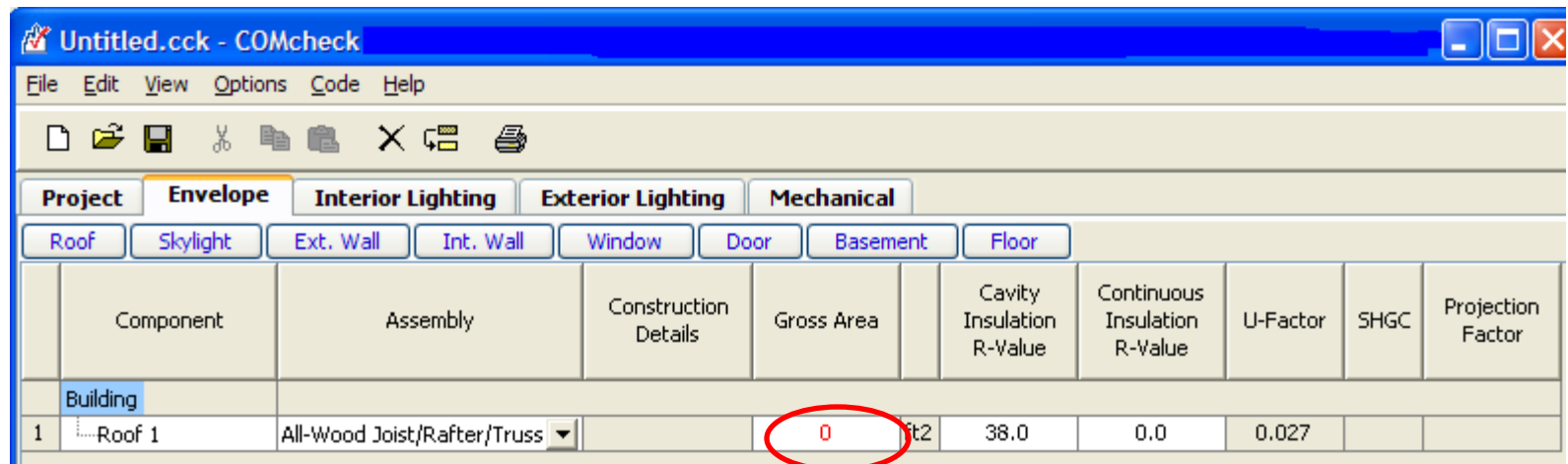
MISSOURI DEPARTMENT OF NATURAL RESOURCES

Screen Operations

Compliance Bar

Status Bar

Colors - Red



Untitled.cck - COMcheck

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical

Roof Skylight Ext. Wall Int. Wall Window Door Basement Floor

	Component	Assembly	Construction Details	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor
1	Roof 1	All-Wood Joist/Rafter/Truss		0	ft2	38.0	0.0	0.027		

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Screen Operations

Compliance Bar

Status Bar

Colors - Green

Colors - Blue



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Screen Operations

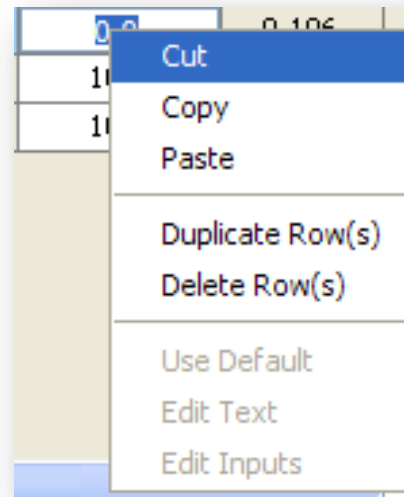
Compliance Bar

Status Bar

Colors

Right Mouse Button

“Context” Menu



ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Additional COMcheck Training Opportunities

- COMcheck 101
- COMcheck 201
- Case studies

www.energycodes.gov

ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Thank You!

